In the United States Court of Federal Claims

OFFICE OF SPECIAL MASTERS

No. 17-259V

Filed: January 13, 2025

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HEATHER GOFF,

Petitioner,

v.

SECRETARY OF HEALTH AND HUMAN SERVICES,

Respondent.

* *

Alison Haskins, Siri & Glimstad, LLP, Aventura, FL, for Petitioner;
Lara A. Englund, U.S. Department of Justice, Washington, DC, for Respondent.

DECISION DENYING ENTITLEMENT[1]

Shah, Special Master:

On February 23, 2017, Heather Goff ("Petitioner") filed a petition for compensation under the National Vaccine Injury Compensation Program, 42 U.S.C. § 300aa-10, *et seq*.[2] (the "Vaccine Act" or "Program"). The petition alleges that Ms. Goff suffered strokes caused by an influenza ("flu") vaccination she received on March 22, 2016. Pet. at 3 (ECF No. 1).

[1] Because this Decision contains a reasoned explanation for the action in this case, it must be made publicly accessible and will be posted on the United States Court of Federal Claims' website, and/or at https://www.govinfo.gov/app/collection/uscourts/national/cofc, in accordance with the E-Government Act of 2002. 44 U.S.C. § 3501 note (2018) (Federal Management and Promotion of Electronic Government Services). This means the Decision will be available to anyone with access to the internet. In accordance with Vaccine Rule 18(b), Petitioner has 14 days to identify and move to redact medical or other information, the disclosure of which would constitute an unwarranted invasion of privacy. If, upon review, I agree that the identified material fits within this definition, I will redact such material from public access.

[2] National Childhood Vaccine Injury Act of 1986, Pub. L. No. 99-660, 100 Stat. 3755. For ease of citation, all "§" references to the Vaccine Act in this Decision will be to the pertinent subparagraph of 42 U.S.C. § 300aa (2012).

I have reviewed the evidence presented in this case, and I conclude that Petitioner has not established by preponderant evidence that the vaccine she received caused her condition. The petition is accordingly dismissed.

I. PROCEDURAL HISTORY

Petitioner filed a signed statement along with the petition. Ex. 1. Subsequently, Petitioner filed medical records and a statement of completion. *See* ECF Nos. 6, 8, 9, 10. On September 11, 2017, Respondent filed a Rule 4(c) Report ("Report"), contending that the case was not appropriate for compensation and should be dismissed. Report at 7-8 (ECF No. 18).

On November 14, 2017, Petitioner filed an expert report and curriculum vitae from Laura S. Boylan, M.D. Exs. 16-17. On November 28, 2017, Petitioner filed medical literature in support of Dr. Boylan's opinions. Exs. 19-33. On June 14, 2018, Respondent filed an expert report from Steven Messé, M.D., along with Dr. Messé's curriculum vitae and medical literature. Exs. A & Tabs 1-5, B. On November 12, 2019, Petitioner filed a supplemental expert report from Dr. Boylan. Ex. 35. Respondent declined to file a supplemental expert report from Dr. Messé. ECF No. 45.

Former Special Master Katherine E. Oler held an entitlement hearing on April 6-7, 2021, by videoconference. Petitioner, Dr. Boylan, and Dr. Messé testified at the hearing. *See generally* Transcript (ECF No. 60). Both parties filed pre- and post-hearing briefs. ECF Nos. 50, 53, 54, 67, 70, 72. After the hearing, Petitioner filed additional medical records and literature, and Respondent filed additional literature. ECF Nos. 63, 65, 69.

On August 13, 2024, this case was reassigned to me. ECF No. 78. The case is ripe for adjudication.

II. FACT EVIDENCE

A. Petitioner's Statement

Petitioner was 43 years old at the time of the subject flu vaccination. Ex. 1 at 1. Her past medical history included hyperthyroidism that was controlled by medication. *Id.* Before the vaccination, she engaged in weightlifting, biking, hiking, and other outdoor activities, and she was employed as a physiotherapist. *Id.*

On September 14, 2015, Petitioner was given a flu vaccination that was required by her employer, Laporte Hospital. Ex. 1 at 1. She said that "[t]his was the first time I had a flu shot in about 18 years." *Id.* She did not have any lingering effects from that vaccination aside from a few days' worth of shoulder pain. *Id.*

In early 2016, Petitioner moved to Arizona and took a job with Banner University Medical Center ("Banner") as a physical therapy ("PT") assistant. Ex. 1 at 1. She was again advised that she would be required to receive a flu vaccination as a condition of employment. *Id.* Although

she reported she had received a flu vaccination a few months earlier, Banner did not have the record of that vaccination, so Petitioner was required to be vaccinated again. *Id.*

Petitioner received the subject flu vaccination on March 22, 2016. Ex. 1 at 1. Her left deltoid was "sore and pink" for the next few days, but those symptoms "seemed to lessen over the next week." *Id.* at 2.

On March 30, 2016, Petitioner woke up with no feeling or control of her right arm, an inability to speak, and right-sided facial drooping. Ex. 1 at 2. Petitioner's roommate took her to the nearest emergency room ("ER"), where she was diagnosed with a 20-30% blockage in her left carotid artery, elevated cholesterol, and a transient ischemic attack ("TIA") in the right parietal lobe. *Id.*

Petitioner received PT and occupational therapy ("OT") in the hospital, and she had a cardiac loop monitor implanted in her left breast. Ex. 1 at 2. She was discharged from the hospital on April 3, 2016. *Id.* On April 20, 2016, she experienced high blood pressure, as well as "continued" left deltoid soreness that extended into her scapular area, shoulder, and jaw. *Id.* She feared that she was having another TIA, so she went to the ER. *Id.* After medical tests came back negative, she was discharged home. *Id.*

On June 24, 2016, Petitioner had a cerebral angiogram, which showed "non-significant stenosis of the right carotid artery and ulcerated plaque on the left carotid artery, causing a narrowing of about 35%[.]" Ex. 1 at 2.

On June 30, 2016, while Petitioner was at work, her supervisor noticed a change in her speech. Ex. 1 at 2. She went to the ER, where she was diagnosed with acute, non-fluent aphasia and admitted. *Id.* She underwent a brain biopsy, which revealed hemorrhage but no neoplasm or infection. *Id.* at 3. She was hospitalized until July 7, 2016. *Id.*

In late July 2016, Petitioner returned to work on a restricted schedule. Ex. 1 at 3. She was unable to fulfill her work duties, however, and was dismissed on September 23, 2016. *Id.* She secured a new job in late 2016. *Id.* She said that she continues to experience numbness and tingling on the right side of her body, along with memory problems and "trouble with numbers and letters." *Id.*

B. Petitioner's Testimony

At the entitlement hearing, Petitioner testified that she was in excellent health and active prior to the subject vaccination. Tr. at 5-6. She was under treatment for her thyroid. *Id.* at 6. She had never suffered a stroke before her vaccination. *Id.*

Petitioner received a flu vaccination on September 14, 2015, at her previous place of employment. Tr. at 6. She was required to receive the vaccination. *Id.* She experienced a few days of arm soreness after that vaccination, but no other symptoms. *Id.*

On March 22, 2016, Petitioner received another flu vaccination that was required by her new employer, Banner. Tr. at 7. She was feeling well at the time of the vaccination. *Id.* After being vaccinated, she had a red, swollen arm for a "couple months." *Id.*

The morning of March 30, 2016, Petitioner went into the kitchen to make coffee. Tr. at 8. She dropped the coffee pod twice. *Id.* She "was feeling kind of funny." *Id.* She then looked in the mirror and noticed that her "face was drooped" and that she could not speak. *Id.* When her roommate saw her, he believed she was having a stroke, so he took her to the hospital. *Id.*

After Petitioner was discharged from the hospital, she had difficulty keeping up with her work responsibilities. Tr. at 10. She still experienced impairments from her stroke, including memory problems and a "constant headache," along with weight gain and fatigue. *Id.* at 10, 12, 14.

Petitioner underwent a cerebral angiogram and had to take off work for the test. Tr. at 10-11. On June 30, 2016, while at work, she was taken to her supervisor's office because she "wasn't talking straight" and was "babbling." *Id.* at 12. Her supervisor suspected another stroke and took her to the ER at Banner. *Id.*at 12-13. She remained in the hospital for a few days and had to undergo a brain biopsy, along with PT, OT, and speech therapy. *Id.* at 13. When she returned to work after being discharged, she had work restrictions. *Id.* at 14. Ultimately, she was dismissed after being unable to keep up with her caseload. *Id.*

Petitioner testified that, since her strokes, she depleted her retirement savings and had to file for bankruptcy. Tr. at 14-15. She can work but has limited her patient load. *Id.* at 14-16. She has had difficulty maintaining relationships. *Id.* at 15. She also has facial asymmetry, and the right side of her face is "droopy and wrinkled." *Id.* at 17. She has right-sided weakness. *Id.* She takes 325mg of aspirin every day. *Id.* She rates her daily symptoms at a 6 out of 10 in severity. *Id.*

On cross examination, Petitioner testified that she could not recall developing any new symptoms, including new memory, speech, or numbness problems, between her first and second strokes. Tr. at 20.

C. Medical Records

The medical records confirm that Petitioner was 43 years old at the time of the subject flu vaccination. Ex. 2 at 1. Her prior medical history included thyroid disease, for which she took Synthroid. Ex. 7 at 16. She had no prior history of stroke.

On September 14, 2015, Petitioner was given a flu vaccination at Indiana University Health. Ex. 14 at 1. On March 22, 2016, she was given another flu vaccination at Banner. Ex. 2 at 1.

There are no medical records between March 22 and 30, 2016. The morning of March 30, 2016, Petitioner was transported to the Abrazo West Campus ("Abrazo") ER complaining of slurred speech, facial droop, and right arm weakness and numbness, with an onset of that morning.

Ex. 6 at 12-14, 280-82. She recalled going to bed the previous night feeling well except for a headache. *Id.* at 14. At the time of triage, the only symptom remaining was right arm numbness. *Id.* at 12. She did not have a fever. *Id.* at 281. An exam showed no evidence of rash, swelling of the left arm, or skin abnormalities. *Id.* The working diagnosis in the ER was an acute ischemic stroke, which was characterized as a "wake-up stroke." *Id.* at 13-14, 280-82. Petitioner was admitted to the hospital. *Id.* at 282.

During an admission exam on March 30, 2016, Petitioner denied any history of prior strokes, TIAs, irregular heartbeat, palpitations, or atrial fibrillation. Ex. 6 at 220. She reported that she had been in "good chronic health." *Id.* She stated that she smoked a little more than a pack of cigarettes daily. *Id.* She also reported that several months earlier, she had a large granuloma removed from the base of a tooth. *Id.* at 221. Again, an exam found no rash or other skin abnormalities, and her extremities had no signs of clubbing, cyanosis, or edema. *Id.* at 222.

On March 30, 2016, Petitioner had a neurology consult with Ahmed El-Gengaihy, M.D., in the hospital. Ex. 6 at 227. Dr. El-Gengaihy noted that a CT scan of the head was normal, but an MRI of the brain revealed a left middle cerebral artery acute infarct measuring 5 x 25 mm. *Id.* at 230. An MRA of the neck without contrast revealed a possible filling defect of the left internal carotid artery. *Id.* An MRA of the head showed no large vessel occlusion. *Id.* A CT angiogram of the neck with and without contrast showed mild atherosclerotic changes in the left internal carotid artery, with a small focal ulcerative plaque and stenosis of 30-40%. *Id.* A transesophageal echocardiogram revealed mild atherosclerosis in the descending aorta but was otherwise normal. Ex. 4 at 25-27; Ex. 6 at 306.

During a consult with cardiologist Rajkumar Sugumaran, M.D., on April 1, 2016, Petitioner reported that "prior to her ER visit she was in her usual state of health." Ex. 6 at 224. She reported the removal of the granuloma and that she had received two flu vaccinations "7 months apart" that year. *Id.* Dr. Sugumaran implanted a cardiac loop recorder to monitor Petitioner's heart for arrhythmias. Ex. 8 at 21.

Lab work undertaken at Abrazo revealed an elevated cholesterol level, and Petitioner was started on a statin. Ex. 6 at 5. Her troponin test was negative, as was urine toxicology. *Id.* at 5, 342. Her C-reactive protein[3] ("CRP") and erythrocyte sedimentation rate ("ESR") levels[4] were

[3] C-reactive protein: a globulin that forms a precipitate with the somatic C-polysaccharide of the pneumococcus in vitro; it is the most predominant of the acute-phase proteins. DORLAND'S MEDICAL DICTIONARY ONLINE ("DORLAND'S"), https://www.dorlandsonline.com/dorland/definition?id=100489 (last accessed January 2, 2025).

[4] Erythrocyte sedimentation rate: the rate at which erythrocytes precipitate out from a well-mixed specimen of venous blood, measured by the distance the top of the column of erythrocytes falls in a given time interval under specified conditions; an increase in rate is usually due to elevated levels of plasma proteins, especially fibrinogen and immunoglobulins, which decrease the zeta potential on erythrocytes by dielectric shielding and thus promote rouleau formation. It is increased in monoclonal gammopathy, hypergammaglobulinemia due to inflammatory disease, hyperfibrinogenemia, active inflammatory disease, and anemia. DORLAND'S, https://www.dorlandsonline.com/dorland/definition?id=102146 (last accessed January 2, 2025).

normal. *Id.* at 342, 350. Her complete blood count ("CBC") did not reveal any evidence of inflammation. *Id.* at 349. Her hypercoagulable workup[5] was normal. *Id.* at 344-48.

Petitioner was discharged from Abrazo on April 2, 2016. Ex. 6 at 5. Her diagnosis at the time of discharge was acute cerebrovascular accident ("CVA"). *Id.*

On April 5, 2016, Petitioner followed up with Dr. Sugumaran. Ex. 8 at 7. Petitioner reported left arm, shoulder, and left-sided neck tightness, with an onset of that morning. *Id.* at 7, 9. She also reported decreased facial sensations. *Id.* at 7. She denied any chest pain, chest pressure, shortness of breath, orthopnea, dizziness, palpitations, presyncope, or syncope. *Id.* Her physical exam was normal except for elevated blood pressure. *Id.* at 8-9. Dr. Sugumaran assessed CVA, hyperlipidemia, hypertension, left arm pain, and tobacco abuse. *Id.* at 10. He counseled Petitioner about quitting smoking. *Id.*

On April 15, 2016, Petitioner submitted a VAERS report in which she stated that she received a flu vaccination on March 22, 2016, and experienced the onset of facial numbness, facial drooping, difficulty speaking, arm and hand numbness, and decreased object recognition and processing sensations beginning on March 30, 2016. Ex. 3 at 1.

On April 20, 2016, Petitioner was brought to the ER by ambulance, complaining of left arm pain that was radiating to her neck and jaw. Ex. 6 at 494. She reported the symptoms began while she was at home. *Id.* She also reported that "she received [the] flu vaccine two weeks ago on [the] affected arm."[6] *Id.* Her neurological exam was normal, and the examining physician noted that she was scheduled to see her neurologist two hours later. *Id.* at 497. Lab results were normal. Ex. 4 at 10-19. She was discharged home with a diagnosis of arm pain of unknown cause. Ex. 6 at 497.

Later that day, Petitioner saw Dr. El-Gengaihy. Ex. 10 at 9. On her intake form, she described her complaint as "[follow-up] after TIA and [left] deltoid flu shot [with] 'fever' in my shoulder, neck, chest and scapular region," which had been ongoing "since" March 22, 2016. *Id.* at 5. She further reported that she had suffered a TIA on March 22, 2016, the day of vaccination. *Id.* Her exam was normal, with no evidence of edema or rashes. *Id.* at 6, 9. Dr. El-Gengaihy ordered a cerebral angiogram to rule out vasculitis. *Id.* at 10.

On May 9, 2016, Petitioner had another follow-up with Dr. Sugumaran. Ex. 8 at 1. Her cardiac loop recorder had detected only one episode of bradycardia since implantation. *Id.* She complained of an itchy scalp but was otherwise doing well from a cardiac standpoint. *Id.* She had no symptoms of angina. *Id.* She reported that she had stopped smoking. *Id.* at 4. Dr. Sugumaran assessed "unchanged" CVA, hyperlipidemia, and hypertension, "improved" tobacco abuse, and "resolved" left arm pain. *Id.* at 3-4.

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[5] Hypercoagulability: the state of being more readily coagulated than normal. Hypercoagulability, DORLAND'S, https://www.dorlandsonline.com/dorland/definition?id=23731 (last accessed January 2, 2025).

[6] In fact, the vaccine had been given 35 days earlier. Ex. 2 at 1.

On June 24, 2016, Petitioner underwent a cerebral angiogram, which found an ulcerated plaque in the left internal carotid artery, causing about 40% narrowing of the artery. Ex. 15 at 673-77. She tolerated the procedure well. *Id.* at 677.

Six days later, on June 30, 2016, Petitioner presented to the ER at Banner with complaints of expressive aphasia. Ex. 15 at 544. She was seen by neurologist Douglas Franz, M.D. *Id.* She could not provide a history due to difficulty speaking. *Id.* Dr. Franz recorded her NIH stroke scale[7] as 1 for right-sided hemisensory changes and 1 for nonfluent aphasia. *Id.* On exam, Petitioner was aphasic but could at times put three words together in a meaningful sentence. *Id.* at 545. She had mild dysnomia, but her comprehension appeared intact. *Id.* She had difficulty with repetition. *Id.* Her facial sensation was diminished on the right side, but her face, tongue, and palate were symmetric. *Id.* Her motor exam and reflexes were normal, but she had diminished light-touch sensation on the right side of her body. *Id.* Dr. Franz noted that Petitioner had a history of stroke earlier that year, with a "probable residual sensory deficit on the right[.]" *Id.* at 546. He recommended admission for treatment with IV tissue plasminogen activator ("tPA") pursuant to hospital protocol. *Id.* at 544-46.

In the hospital, Petitioner underwent another MRI of the brain that showed a 2.3-cm left thalamic lesion, which was potentially consistent with a subacute infarct but was also concerning for neoplasm. Ex. 15 at 550. She also had a CT angiogram of the neck, which was interpreted as showing bilateral carotid webs, with the more prominent web in her left internal carotid artery. *Id.* at 473. The interpretation was that neither web appeared hemodynamically significant. *Id.* at 474.

On July 3, 2016, Petitioner was seen by neurosurgeon Jose Menendez, M.D., who was concerned she might have a high-grade glioma. Ex. 9 at 5. She underwent a brain biopsy on July 5, 2016, which showed that the tissue exhibited "hemorrhage, reactive gliosis and foamy histocyte infiltrate." *Id.* at 9-11. The foamy cells were felt to be consistent with a history of stroke. *Id.* at 7. There was no evidence of neoplasm or infection. *Id.* The pathology report stated that the tissue showed "an inflammatory-reactive process characterized by sharply demarcated foci of damage containing clusters of wall-to-wall macrophages, rimmed by enlarged/tortuous axonal profiles (axonal spheroids), parenchymal and perivascular chronic inflammation and reactive vessels." Ex. 15 at 785.

On July 7, 2016, Petitioner was discharged from Banner to home. Ex. 15 at 8-9. Her discharge diagnoses included left thalamus lesion, status post left frontal burr hole for stereotactic needle biopsy; history of left thalamic stroke; and aphasia, status post IV tPA given for concern for CVA. *Id.* She had undergone PT, OT, and speech therapy in the hospital. *Id.* at 9. At the time of discharge, she was able to walk without assistance, though she still had aphasia, which had

[7] The NIH stroke scale is "widely used [to help] health care providers assess the severity of a stroke. Health care providers use it to measure neurological function and deficits by asking the person to answer questions and perform several physical and mental test…. Using a numerical scale to determine stroke severity, health care providers record the person's performance in 11 categories, such as sensory and motor ability." NIH, NIH Stroke Scale, https://www.ninds.nih.gov/health-information/stroke/assess-and-treat/nih-stroke-scale (last accessed on January 2, 2025). A score of 1 is defined as "1 = Not alert; but arousable by minor stimulation to obey, answer, or respond." *Id.*

persisted throughout her hospitalization. *Id.* She was instructed not to drive. *Id.* She was referred for outpatient speech therapy. *Id.*

On July 15, 2016, Petitioner followed up with her primary care physician ("PCP"), Peter Young, M.D. Ex. 4 at 5. Her exam was normal. *Id.* at 7-8. Dr. Young advised her to stop smoking. *Id.* at 9. On July 18, 2016, Petitioner returned to Dr. Young so that leave-related forms could be completed. *Id.* at 1. On October 3, 2016, she saw Dr. Young to discuss lab results relating to her thyroid condition. *Id.* at 28. Her exam was normal, but she had low TSH levels. *Id.* at 30. The plan was to decrease her Synthroid dosage and recheck her TSH in two months. *Id.* at 31.

On February 13, 2018, Petitioner saw Dr. Franz. Ex. 37 at 1. Dr. Franz noted that she had experienced two cryptogenic strokes. *Id.* He commented that she had a history of carotid web. *Id.* At the time of the visit, Petitioner complained of right-sided sensation changes, skin sensitivity to touch, post-stroke depression, and headaches. *Id.* Dr. Franz assessed depressive disorder, central pain syndrome, and stroke. *Id.* at 2. He noted that Petitioner had a "history of left peri-insular and left thalamic stroke the former of which may be related to left carotid web and the second may have been a periprocedural [complication]." *Id.* He prescribed duloxetine for pain and depression, along with aspirin, and referred Petitioner to a psychologist. *Id.*

In 2019, Petitioner was diagnosed with Crohn's disease, for which she was prescribed Lialda.[8] *See* Ex. 40 at 159. She moved to California and established care with Kaiser Permanente. *See generally* Ex. 40. On July 2, 2020, she had a telehealth visit with Florence Leung, M.D., during which she complained of gastrointestinal symptoms but no neurologic ones. *Id.* at 71. Her records indicated a remote history of CVA. *See, e.g., id.* at 159.

On August 28, 2020, Petitioner sent electronic messages to Dr. Leung complaining of headaches on the side of her head on which she had experienced the strokes. Ex. 40 at 178-79. She requested a referral to a neurologist. *Id.* Dr. Leung prescribed nortriptyline, but Petitioner later reported that the medication gave her unusual dreams and did not work, so she stopped taking it. *Id.* at 178. There is no indication that Petitioner saw a neurologist for her headaches. There are no further relevant medical records.

III. EXPERT EVIDENCE

A. Petitioner's Expert: Laura S. Boylan, M.D.

1. Qualifications

Dr. Boylan authored two expert reports in this case. Ex. 16 ("First Boylan Rep."); Ex. 35 ("Second Boylan Rep."). She received her M.D. in 1994 from the Columbia University College of Physicians & Surgeons. Ex. 18 ("Updated Boylan CV") at 1. She completed a residency in neurology at The Neurological Institute at Columbia-Presbyterian Medical Center, and a post-doctoral clinical research fellowship at The Neurological Institute and New York State Psychiatric Institute. *Id.* at 2.

[8] Petitioner's diagnosis was later changed to ulcerative colitis. Ex. 40 at 200.

According to the documents in the record and the hearing testimony, Dr. Boylan is board certified in neurology and is an attending neurologist at Bellevue Hospital Center in New York City. *Id*. She has also worked as a neuro-hospitalist at Essentia Health in Duluth, Minnesota, where she has covered the stroke service. First Boylan Rep at 1; Tr. at 25-26. She has taught neurology at New York University School of Medicine in several different roles. Updated Boylan CV at 2. She estimated that she has diagnosed and treated more than 1,000 patients with stroke and more than 100 cases of post-infectious neurological symptoms. First Boylan Rep. at 2.

Dr. Boylan is a member of the American Academy of Neurology, the American Neurological Association, and the Movement Disorder Society. Tr. at 24. She has served as an ad hoc reviewer for *Neurology*, *Brain*, *Epilepsia*, *BMJ Case Reports*, *Seizure*, *Epilepsy & Behavior*, and other publications. Updated Boylan CV at 3-4. She also served on the editorial board of *Practical Reviews in Neurology*. *Id.* at 4. She has authored 11 peer-reviewed papers and 10 abstracts. *Id.* at 8-9, 12.

2. Dr. Boylan's First Expert Report

Dr. Boylan explained that "[t]here is substantial evidence that inflammation plays a role in stroke." First Boylan Rep. at 3. Vaccinations provoke the immune/inflammatory system, "inducing a series of cellular and molecular events in the body referred to as an 'inflammatory cascade.'" *Id.* Although this response is protective in the "vast majority of individuals," it rarely can be harmful. *Id.*

Dr. Boylan noted that "influenza vaccination has been shown to decrease cardiovascular risk at the population level[.]" First Boylan Rep. at 3. But "this does not indicate that Ms. Goff's influenza vaccinations did not cause or contribute to her stroke." *Id.* She observed that acute infections, including flu infection, have been associated with an increased risk of vascular events. *Id.* "[T]his observation has raised concern that vaccination itself could be associated with increased short term stroke risk," based on a "plausible scientific basis for causality." *Id.*

Although the flu vaccination is generally recommended once a year, Dr. Boylan pointed out that some populations, like infants and children, are given booster doses to ensure adequate protection. First Boylan Rep. at 3-4. This suggests that the clinical response to vaccination – including the potential for adverse response – is affected by the frequency of vaccination and the total dose of vaccine given. *Id.* at 4. Petitioner received two flu vaccinations during one season, which might have produced an enhanced immune provocation and a "higher risk of adverse events." *Id.*

Dr. Boylan stated that the "event of March 30, 2016 was clearly a stroke," and the "event of June 30, 2016 was most likely a second stroke, but there is a possibility that it represents primarily inflammation or progression/extension of the first stroke." First Boylan Rep. at 5. Petitioner's imaging revealed the presence of bilateral carotid webs, worse on the left than the right. *Id.* at 9. A carotid web is "a particular abnormality in the wall of one of the major vessels which provides blood to the brain." *Id.* at 5. These carotid webs increased Petitioner's propensity for stroke. *Id.* Notably, "[t]he web is most prominent on Ms. Goff's left side and that is the side

where she had both strokes." *Id.*

Petitioner's June 30, 2016 brain imaging "showed a stroke in the territory supplied with blood which passes through the carotid web." First Boylan Rep. at 9. That imaging showed a second lesion that was distinct from the first stroke on March 30, 2016, but adjacent to the previous stroke. *Id.* Dr. Boylan agreed with Petitioner's treating physicians that the lesion from the second event "did not look like a stroke," because it was deep and irregular, suggesting that it might have been caused by a tumor or infection. *Id.*

Dr. Boylan explained that repeated strokes in a woman in her forties are "extremely rare," and the decision to perform a biopsy of the lesion illustrates "how atypical and unusual Ms. Goff's clinical situation and brain imaging were." First Boylan Rep. at 9. The biopsy revealed abundant inflammatory cells and demonstrated an active inflammatory process that was sufficient to light up on an MRI, another unusual occurrence. *Id.* at 9-10. Dr. Boylan concluded that "[t]he tissue biopsy provided [a] definitive diagnosis of an active inflammatory process and did not show changes associated with tumors or infections." *Id.* at 10.

Dr. Boylan noted that Petitioner's "extensive stroke evaluation did not reveal any apparent cause of stroke other than the carotid webs." First Boylan Rep. at 10. The role of carotid webs in predisposition to stroke is an "emerging area" of medicine. *Id.* In Dr. Boylan's opinion, the carotid webs made Petitioner particularly vulnerable to strokes. *Id.*

Dr. Boylan also identified a tendency toward inflammation as a risk factor for Petitioner. Inflammation promotes blood clotting, or thrombosis, increasing the risk of stroke. First Boylan Rep. at 10. Petitioner had a history of allergies, recurrent shingles, and thyroid disease, all of which are "associated with abnormalities in the immune/inflammatory system and may have predisposed her to stroke from either or both excessive clot formation or abnormalities in the vessel walls in the setting of carotid webs." *Id.* Furthermore, her history of granuloma requiring surgical removal signified a propensity toward inflammation. *Id.*

Dr. Boylan noted that, according to the National Stroke Association Stroke Risk Calculator, Petitioner's history of smoking increased her risk of stroke by only 0.4% over ten years.[9] First Boylan Rep. at 10. Overall, her risk as a young adult was low. *Id.*

Dr. Boylan observed that flu infections are associated with strokes, but she acknowledged that there have been few cases of stroke after the flu vaccine. First Boylan Rep. at 11. Nonetheless, "in rare individuals, [stroke] will occur as a post-vaccine phenomenon even though vaccination reduces overall risk in the population." *Id.*

Dr. Boylan concluded that the September 14, 2015 and March 22, 2016 flu vaccines together "most likely provoked an immune/inflammatory response which caused or contributed to the occurrence and severity of the strokes [Petitioner suffered]." First Boylan Rep. at 11. Petitioner had several risk factors that might have predisposed her to a stroke triggered by the

[9] Dr. Boylan pointed out that this stroke risk calculator does not even permit calculation of risk for people under age 45. First Boylan Rep. at 10.

inflammatory response initiated by the vaccines. *Id.* Petitioner's inflammation was "particularly strong," particularly with her second stroke, as evidenced by her imaging. *Id.*

3. Dr. Boylan's Second Expert Report

In a brief response to Dr. Messé's expert report (discussed below), Dr. Boylan clarified that, in her opinion, Petitioner's brain MRI following the second event was unusual because it showed sufficient inflammation to cause a suspicion of tumor or infection, requiring biopsy. Second Boylan Rep. at 1. Her conclusions were unchanged.

4. Dr. Boylan's Testimony

Dr. Boylan was recognized as an expert in neurology. Tr. at 31. She defined a stroke as "local damage to the brain in a particular area related to the blood flow and the vascular structures of the brain." *Id.* Strokes are generally categorized as either ischemic, characterized by choking off blood supply to the brain, or hemorrhagic, characterized by bleeding into the brain. *Id.* at 32. They can be caused by emboli that develop in the heart or other parts of the body, including arteries or veins, and then break off and travel to the brain. *Id.* at 32-33. Dr. Boylan's opinion was that Petitioner suffered from an ischemic, artery-to-artery, thromboembolic stroke, likely arising in the artery with the carotid web. *Id.* at 33-34.

Dr. Boylan testified that both chronic and acute inflammation play a major role in stroke. Tr. at 34. Patients with severe systemic inflammation can develop strokes. *Id.* Inflammation from non-infectious causes also can trigger stroke. *Id.* at 36. The walls of the blood vessels in the brain are "very sensitive to the effects of inflammation." *Id.* at 37. The more inflammation a person experiences in response to a stroke, the worse the outcome might be. *Id.* at 50. Medications with anti-inflammatory properties are given to treat strokes. *Id.* However, "not every inflammation will provoke a stroke, and not every stroke will be caused by inflammation[.]" *Id.* at 39. Furthermore, stroke itself causes an inflammatory response. *Id.*

According to Dr. Boylan, one of the main sources of inflammation is the endothelium, which is the innermost lining of the blood vessels. Tr. at 40. The endothelium within the brain is proximate to immune cells called glial cells. *Id.* at 52. The glial cells excrete endothelium-related growth factor, along with chemokines and cytokines that "are actively in communication with the blood and with messengers within the blood." *Id.* Inflammation will cause changes in vascular reactivity, or endothelial-dependent relaxation, which can impair the ability of blood to circulate through the brain. *Id.* at 53-54. Dr. Boylan testified that a study showed that certain biomarkers and changes in vascular reactivity were evident two weeks after flu vaccination in healthy individuals. *Id.* (referencing Smeeth L, et al., *Risk of Myocardial Infection and Stroke after Acute Infection or Vaccination,* N. ENGL. J. MED. (2004);351(25):2611-2618 (Ex. 31) ("Smeeth")).

Dr. Boylan stated that Smeeth explored the possible association between vaccination and stroke. Tr. at 37. The authors posited that systemic inflammation could "pull the trigger" for a vascular event, such as a stroke, that might not have otherwise occurred. *Id.* at 37-38. Both infections and vaccines are pro-inflammatory and could, theoretically, cause a stroke. *Id.* at 38. Although the Smeeth study found that the flu vaccine reduced the risk of stroke in the population

by 40-60%, according to Dr. Boylan, that finding does not rule out the possibility that "rare individuals" will experience adverse effects from the vaccine, including stroke. *Id.* at 38.

Dr. Boylan testified that systemic inflammation affects stroke risk. Tr. at 54. She stated that it was "conventional wisdom to the point of dogma[] that infection promotes thrombosis." *Id.* Also, according to the Cardenas paper, both viral infection and vaccination could promote blood-brain barrier dysfunction, "producing neuroinflammation and neurological disorders." *Id.* at 44; *see* Cardenas G, et al., *Neurological events related to influenza A (H1N1) pdm09*, INFLUENZA AND OTHER RESPIRATORY VIRUSES (2014);8(3):339-346 (Ex. 19) ("Cardenas"). The inflammatory response in a given individual "may be modulated by individual biological factors, like age, sex, [and] genetic background." Tr. at 42-43. Additionally, the McColl article supported the notion that an inflammatory response unfolds in a cascade of events, and people will have a broad range of symptoms as a result. *Id.* at 45-46; *see* McColl BW, et al., *Systemic Infection, Inflammation and Acute Ischemic Stroke*, NEUROSCIENCE (2009);158:1049-1061 (Ex. 27) ("McColl"). McColl observed that the highest risk period for stroke occurs during the greatest pro-inflammatory phase of the immune response. Tr. at 45.

Dr. Boylan next explained that a carotid web "is an abnormal formation on a vessel, like a little ledge within the vessel." Tr. at 56. Carotid webs are a risk factor for stroke because vascular abnormalities "promote the creation of thrombus." *Id.* at 55-56. The abnormal formation of the vessel disturbs the usual flow within the vessel, similar to rocks disturbing the flow of water in a river. *Id.* at 56, 61. Carotid webs are "one of the causes of stroke and recurring stroke in young women who you would not otherwise expect to have a stroke." *Id.* at 57. Even small carotid webs are associated with increased stroke risk. *Id.* at 65.

Based on her review of Petitioner's imaging, Dr. Boylan agreed that Petitioner had bilateral carotid webs, with the larger one in her left internal carotid artery, which was located upstream from where her first stroke occurred. *Id.* at 64. These carotid webs predisposed Petitioner to strokes and would be classified as an "anatomic prothrombotic substrate."[10] *Id.* at 77. Further, the combination of this anomaly with the inflammation induced by a vaccination would enhance this risk. *Id.* at 79.

Dr. Boylan referenced the Lin case report, in which the authors broadly stated that "vaccination provokes a variable magnitude of inflammatory and immunological response that modifies the risk for ischemic stroke," and "an inflammatory/immunological response after vaccination may trigger thrombosis superimposing a preexisting prothrombotic state." Tr. at 77-78; *see* Lin YP, et al., *Ischaemic stroke and influenza A H1N1 vaccination: a case report*, ARCH MED. SCI. (2011);7(2):345-348) (Ex. 26) ("Lin"). Furthermore, the fact that Petitioner had not had a stroke prior to vaccination made it "very hard to say" that the vaccination and the stroke were unrelated. Tr. at 77-78. Additionally, the March 22, 2016 vaccination could have elicited a booster

[10] Dr. Boylan testified that she was somewhat confused by Petitioner's June 30, 2016 CT angiogram, which reported multiple infarcts or an "embolic shower" from multiple sources. Tr. at 74-75. The scan also showed that Petitioner's second stroke did not seem to have occurred downstream from the left carotid web. *Id.* at 76. This confusion did not alter her opinion that Petitioner suffered from carotid webs, which predisposed her to strokes. *Id.* at 77.

effect, given that it was administered only six months after her previous flu vaccination. *Id.* at 83. This could have produced additional inflammation. *Id.*

Dr. Boylan testified that carotid webs "are quite dangerous" and can cause recurrent strokes. Tr. at 83. The fact that Petitioner had a stroke after receiving the vaccination, but had not experienced any strokes since 2016, caused Dr. Boylan to conclude that "the vaccine triggered the stroke to a level of certainty that I would make a clinical decision on that basis." *Id.* at 84.

Dr. Boylan testified that Petitioner was feeling unwell and experienced localized arm pain and swelling after vaccination, indicating a clinically notable inflammatory response to the vaccination. Tr. at 47-48. Petitioner did not have any contemporaneous triggers for an acute inflammatory response other than the flu vaccination. *Id.* at 69. A stroke occurring eight days after vaccination was within the expected time frame for such an event. *Id.* at 48.

Dr. Boylan opined that she would recommend against Petitioner receiving future flu vaccinations. Tr. at 85. Petitioner had a low risk of dying from the flu; therefore, the protection she would receive from the flu vaccine would not outweigh the risk of another stroke. *Id.*

Regarding Petitioner's second stroke, Dr. Boylan noted that it was "strange in a number of ways." Tr. at 85. That episode occurred after a needle angiogram, which is associated with a risk of stroke. *Id.* at 86. The event did not occur in the carotid artery or around any anomalous vasculature. *Id*. Dr. Boylan opined that the second stroke might have been triggered by the angiogram procedure. *Id.* She clarified that she did not believe the second stroke was directly caused by the vaccination; instead, it resulted from the treatment given for the first stroke, which she maintained was vaccine caused. *Id.* at 87.

Dr. Boylan did not believe Petitioner's history of smoking caused her stroke. Tr. at 88. Based on her evaluation of Petitioner's smoking habits, her carotid webs, and her flu vaccination, Dr. Boylan did not think Petitioner's smoking or carotid webs were enough to cause the first stroke without the catalyst of the vaccination. *Id.* at 91.

In summary, Dr. Boylan opined:

> [The vaccination,] through a direct effect or through its pro-inflammatory stimulation possibly, and also with the booster effect, adduced an acute inflammatory response, which, in turn, triggered an inflammatory cascade, which includes a prothrombotic state, and that triggered abnormal blood flow over her preexisting carotid webs, formed a thrombus, which flew downstream and caused a stroke.

Tr. at 94. She added that "the vaccine induced a pro-inflammatory state which promoted the formation of a clot in Ms. Goff's preexisting carotid web and that there was a subsequent breakup of that clot, and it went downstream and caused her stroke." *Id.* at 129.

On cross examination, Dr. Boylan acknowledged that the Smeeth study, which included 19,000 subjects, revealed a decreased risk of stroke after flu vaccination compared to after

infection. Tr. at 95. She broadly agreed with the authors' finding that flu vaccination is not associated with a detectable increase in the risk of vascular events at the population level, but she did not believe that finding was applicable to Petitioner, because the study was "not designed to detect or capable of detecting rare events or exclusion of events." *Id.* at 97-98. She allowed that, in general, a natural flu infection would produce a more robust inflammatory response than the typical response to a vaccination. *Id.* at 103.

Dr. Boylan testified that she did not believe every stroke was caused by inflammation. Tr. at 101. It is difficult to ascertain whether a stroke has been caused by an inflammatory trigger. *Id.* To make that determination, one would "look at certain inflammatory markers" like ESR and CRP. *Id.* Dr. Boylan maintained that Petitioner "had all of the classical symptoms of an inflammatory response of some magnitude, undefined magnitude, before she had a stroke," but she acknowledged that there was no evidence in the medical records that she had a fever, flu-like symptoms, or lab work showing inflammation or a prothrombotic state. *Id.* at 101-02, 113. Instead, she pointed out that Petitioner self-reported experiencing a "fever" in her shoulder, neck, chest, and scapular region after the March 22, 2016 vaccination. *Id.* at 121-23.

Dr. Boylan acknowledged that her causal theory was not specific to the flu vaccine. Tr. at 104. Her theory suggests that any inflammatory stimulus could trigger a stroke, but she admitted that other inflammatory events, such as poison ivy exposure, seasonal allergies, and bee stings, are not associated with stroke. *Id.* at 104-05. She confirmed that most strokes in patients under 50 are idiopathic, and she agreed that none of Petitioner's treating physicians attributed her stroke to her vaccination. *Id.* at 106-07. She acknowledged that the studies she submitted involved strokes in younger patients with carotid webs who had no identified inflammatory triggers. *Id.* at 106-09.

Dr. Boylan testified that her proposed causal mechanism involved both the innate and adaptive immune systems, but primarily the innate immune system. Tr. at 114. She stated that there was no specific time frame during which she would expect an inflammatory process to occur and trigger a stroke. *Id.* at 115-16. She stated that the Vaccine Injury Table gives some guidance, and she believed any injury occurring within six to eight weeks of vaccination might be considered autoimmune in nature. *Id.* at 116. Any injury occurring six months after vaccination would not be attributable to the vaccine. *Id.* She could not say how long the innate immune system response to a flu vaccination would continue, but she was "confident that it lasts at least as long as the time period from the second vaccine to the first stroke." *Id.* at 119.

In response to a question from Special Master Oler, Dr. Boylan testified that certain types of infections increase the risk of stroke, including flu, zoster, bacterial blood infections, syphilis, tuberculosis, cryptococcus, and fungal infections. Tr. at 126. She opined that in principle, if a viral infection can induce stroke, then the vaccination against that infection could as well. *Id.*

On redirect examination, Dr. Boylan clarified that the McColl study showed that the highest risk of stroke occurred within one week of infection. Tr. at 130-31. This corresponded to the time during which the systemic inflammatory response was strongest. *Id.*

B. Respondent's Expert: Steven Messé, M.D.

1. Qualifications

Dr. Messé authored one expert report in this case. *See* Ex. A ("Messé Rep."). According to the documents in the record and the hearing testimony, he is an Associate Professor in the Division of Vascular Neurology at the University of Pennsylvania. Messé Rep. at 1. He received his M.D. from the University of Michigan School of Medicine. Ex. B ("Messé CV") at 1. He completed his neurology residency and a stroke and neurocritical care fellowship at the University of Pennsylvania. *Id.* He is board certified in neurology and vascular neurology, which is the area of neurology that focuses on cerebrovascular diseases such as stroke. *Id.* at 2; Tr. at 142. His clinical practice specializes in patients with cerebrovascular disease, and he has treated thousands of stroke patients. Tr. at 142, 221. He also conducts clinical research, primarily focused on stroke. *Id.* at 142.

Dr. Messé has served as an ad hoc reviewer for publications such as *Neurology*, *Stroke*, *Journal of Neuroimaging*, *The New England Journal of Medicine*, and *Lancet*. Messé CV at 2-3. He has published about 70 peer-reviewed papers. *Id*. at 6-13. He is a member of the American Academy of Neurology, the American Heart Association, and the American Stroke Association. Tr. at 144. At the time of the hearing in this case, he was serving as the chair of the American Stroke Association's Stroke Systems of Care Advisory group, which oversees a large database of stroke incidents used by clinicians to improve treatment. *Id.* at 144-45.

2. Dr. Messé's Expert Report

Dr. Messé opined that Petitioner's recurrent ischemic strokes were not related to the March 22, 2016 flu vaccination. Messé Rep. at 3. He stated that the literature "strongly supports the notion that influenza vaccination is associated with a *reduced*, not *increased*, risk of stroke." *Id.* (emphasis in original). For example, the Grau study showed that vaccination was less common in stroke patients compared to control subjects. *Id.*; *see also* Grau AJ, et al., *Influenza Vaccination Is Associated With a Reduced Risk of Stroke*, STROKE (2005);36:1501-1506 (Ex. 23) ("Grau"). The Siriwardena study similarly reported a 24% reduced risk of stroke in those who were vaccinated. Messé Rep.at 3; *see also* Siriwardena AN, et al., *Influenza and pneumococcal vaccination and risk of stroke or transient ischemic attack – Matched case control study*, VACCINE (2014);1354-1361 (Ex. 30) ("Siriwardena"). The Smeeth study found no increased risk of stroke after flu vaccination. *Id.* The medical literature supplied by Dr. Boylan also mostly supported the notion that flu vaccinations are "robustly protective" against stroke. *Id.* Dr. Boylan cited just two case reports for her claim that a causal association exists between vaccination and stroke; one of those involved a varicella vaccination, not flu. *Id.* at 3-4.

In describing Petitioner's imaging, Dr. Messé noted that Petitioner's first stroke was a "left middle cerebral artery embolic-appearing stroke." Messé Rep. at 4. She had an ulcerated plaque in the internal carotid artery, resulting in 30-40% stenosis. *Id.* The risk of stroke is significantly increased when there is greater than 50% stenosis, but lesser degrees of stenosis are also associated with an increased risk. *Id.* Furthermore, ulcerated plaque is associated with an even higher risk of stroke, because "[t]he rupture or endothelial erosion of an unstable, atherosclerotic plaque leads

to thrombus formation, which then may embolize distally." *Id.* Dr. Messé's opinion was that Petitioner's stroke was related to her carotid lesion. *Id.*

In his report, Dr. Messé disagreed that Petitioner had a carotid web. Messé Rep. at 4. He noted that she underwent a conventional angiogram, which is the gold standard for evaluation of blood vessel abnormalities, and the radiologist interpreting the study concluded that her carotid stenosis was caused by an ulcerated atherosclerotic plaque, not a carotid web. *Id.* Furthermore, regardless of whether she had stenosis caused by a carotid web or plaque, "it seems unnecessary to blame the vaccination . . . [which] is associated with a reduced stroke risk." *Id.*

Dr. Messé strongly disagreed with the claim that Petitioner had an unusual degree of inflammation in the brain following her second stroke. Messé Rep. at 4. He noted that "[e]nhancement on MRI after stroke is very common after the first day or two, and typically persists for weeks." *Id.* Petitioner's biopsy was clearly consistent with a subacute infarction, and the pathologists analyzing the biopsied tissue did not report finding abnormal inflammation. *Id.*

Dr. Messé opined that the MRI indicated that Petitioner's second, thalamic infarct occurred at the time of her cerebral angiogram on June 24, 2016. Messé Rep. at 4. He noted that infarcts visible on MRI are common after cerebral angiograms. *Id.* He concluded that the second stroke was iatrogenic, meaning it was caused by the medical care given to her for the first stroke. *Id.* at 4-5.

Dr. Messé pointed out that it is very common for strokes to be cryptogenic, with no clear cause identified, particularly in younger patients. Messé Rep. at 5. "This uncertainty . . . does not provide support for the notion that the stroke was caused by the vaccination, particularly when the evidence suggests that vaccinations are protective overall." *Id.* He concluded that Petitioner's history as a tobacco user, coupled with her mild hyperlipidemia and ulcerated atherosclerotic plaque, likely caused her initial stroke. *Id.* Further, if she did have a left carotid web, "that also would be a plausible mechanism for the stroke." *Id.* He opined that it was "highly likely that the second stroke was related to the cerebral angiogram that [Petitioner] received one week prior to the MRI." *Id.*

3. Dr. Messé's Testimony

Dr. Messé was recognized as an expert in neurology and vascular neurology. Tr. at 145. He characterized Petitioner's stroke on March 30, 2016, as a left middle cerebral artery stroke. *Id.* at 155.

Dr. Messé testified that Petitioner had a number of risk factors for stroke, including elevated LDL cholesterol, smoking, and an anomaly in her carotid artery, which was either a carotid web or atherosclerosis. Tr. at 155. Addressing the imaging of Petitioner's carotid arteries, Dr. Messé explained that Petitioner had a conventional angiogram on June 24, 2016. *Id.* at 155. A conventional angiogram is an invasive procedure during which a radiologist or interventional neurologist inserts a catheter through the groin and into the blood vessels in the neck. *Id.* at 156. Although this procedure is considered the gold standard for assessing the blood vessels, it does not image the walls of the blood vessels, and it carries the risk of brain injury caused by the catheter

dislodging a blood clot or plaque. *Id.* In Petitioner's June 24, 2016 angiogram, a neurosurgeon found a complex ulcerated atherosclerotic plaque, causing a 40% narrowing of the carotid artery. *Id.* at 156-57.

When Petitioner went to the hospital on June 30, 2016, she had a CT angiogram of the head and neck. Tr. at 157. Dr. Messé testified that a CT angiogram is a noninvasive procedure in which contrast is injected into the blood vessels while the patient is in a CT scanner. *Id.* Petitioner's radiologist interpreted her CT angiogram to show a carotid web, not atherosclerosis. *Id.* at 158. At the hearing, and in contrast to his expert report, Dr. Messé favored carotid web as the proper diagnosis. *Id.* at 159; *compare* Messé Rep. at 4. This was, in part, because he did not see a significant overall atherosclerosis burden in Petitioner's body. *Id.* He clarified that the physicians performing the June 24 and June 30, 2016 studies both observed the same lesion in Petitioner's carotid artery, but they interpreted it differently. *Id.*

Dr. Messé opined that ultimately, the characterization of Petitioner's carotid abnormality was irrelevant, because either a carotid web or an ulcerated atherosclerotic plaque with 30-40% stenosis could be a plausible mechanism for stroke. Tr. at 160. Dr. Messé defined a carotid web as an abnormal growth in the lining of a blood vessel, caused by abnormal collagen deposition in the lining. *Id.* at 160-61. A carotid web tends to develop at the carotid bifurcation, where the common carotid artery splits into the external and internal arteries. *Id.* at 161. A carotid web could, by itself, cause a stroke, without the need for a catalyzing trigger such as a vaccination. *Id.*

Dr. Messé opined that typically stroke patients are older, but about 30% of strokes occur in patients under the age of 65. Tr. at 166-67. The mechanisms for stroke in older patients are typically different than in younger patients. *Id.* at 167. There is ample literature supporting carotid web being a risk factor for stroke in younger people. *Id.* Petitioner was in the appropriate age group for a carotid web-caused stroke. *Id.*

Dr. Messé also discussed the thalamic lesion on Petitioner's June 30, 2016 MRI. Tr. at 167. He noted that Petitioner's clinical presentation was consistent with a subacute stroke, rather than an acute stroke. *Id.* at 168. The biopsy was performed because her treating physicians were concerned the lesion was a tumor, not because of a concern about inflammation or vasculitis. *Id.* A suspicion of an inflammatory or vasculitis-related stroke would not have required a biopsy. *Id.* Dr. Messé testified that the biopsy was "completely consistent" with a subacute stroke and did not show a tumor; the biopsy also confirmed there was inflammation, but, in his opinion, that inflammation was a natural response to the stroke and not its cause. *Id.* at 168-69.

Dr. Messé opined that there was no evidence in the literature that the flu vaccine can cause a stroke. Tr. at 169. He identified Smeeth as the best study addressing this question. *Id.* at 169-70. That study was conducted in the United Kingdom, which has a nationalized health system and a large collection of patient records. *Id.* at 170. The study subjects had an exposure to either an infection, a tetanus vaccination, a pneumococcal vaccination, or a flu vaccination, and had suffered a stroke within a year of exposure. *Id.* at 171. The investigators compared the risk of stroke during the 90-day period following infection/vaccination with the risk during a baseline period with no such exposures. *Id.* The study assessed more than 19,000 patients who had a flu vaccination and a stroke. *Id.* at 171-72. The incidence of stroke was lower for flu vaccinated patients during the

risk period than during the baseline period. *Id.* at 172. Conversely, subjects who had infections were at increased risk of stroke during the risk period compared to the baseline period. *Id.* at 173. Dr. Messé concluded that the Smeeth study was "very reassuring that the vaccinations are not causing strokes." *Id.* He felt that, if there was a safety signal of increased risk of stroke from flu vaccination, it would have been detected by the study. *Id.* at 172-73.

Dr. Messé also discussed the Siriwardena paper, a retrospective case-control study that compared vaccinated patients who suffered strokes to those who did not. Tr. at 173-74; *see generally* Siriwardena. He explained that, "after adjusting for all known and obvious and known risk factors for stroke . . . people who got the vaccination had much lower risk of stroke, and it actually is kind of the opposite, because people who had a stroke were much less likely to have been vaccinated[.]" Tr. at 174. The Siriwardena study concluded that vaccinated subjects had a 24% reduction in stroke risk. *Id.* Dr. Messé characterized the study as "well done." *Id.* The Grau study was similarly constructed and found that the odds of stroke were reduced by "more than half" in vaccinated patients compared to unvaccinated patients. *Id.* at 174-75; *see* Grau at 1504. This finding was "very reassuring[] that vaccinations are not causing strokes." Tr. at 175.

Dr. Messé also discussed the Lin case report, which described a 75-year-old who experienced a stroke after vaccination. Tr. at 175; *see* Lin at 345. He found the case report "uncompelling," stating that "a 75-year-old having a stroke is not a big surprise." Tr. at 175. The subject of the report had experienced a prior stroke, had hypertension, and was not taking aspirin, all of which heightened his stroke risk. *Id.* at 224. The authors provided no evidence for their statement that "an inflammatory immunological response after vaccination may trigger thrombosis, superimposing a preexisting prothrombotic state." *Id.* at 175. Dr. Messé pointed out that flu vaccination is not contraindicated in patients with a preexisting prothrombotic state; in fact, they are "important for people at risk of vascular disease in particular." *Id.* at 176, 206.

Dr. Messé testified that the Cardenas paper addressed autoimmune responses to vaccination, but it provided "no evidence that vaccinations are actually causing these disorders," other than observational case reports. Tr. at 176-77.

Contrary to Dr. Boylan's view, Dr. Messé did not find any evidence in Petitioner's medical records that she had an inflammatory reaction to the subject flu vaccination prior to the stroke, such as redness or swelling in her arm, edema, purpura, ecchymoses, rash, or fever. Tr. at 162-65. He stated: "I didn't see anything that a doctor or nurse documented about recently feeling unwell prior to the stroke." *Id.* at 162. Her records on the day of admission indicated that she had been in her "usual state of health" before the onset of the stroke, indicating that she had no complaints between the vaccination and the stroke. *Id.* at 162-63. Petitioner's CRP, ESR, white blood cell ("WBC") count, and platelet levels were all normal at the time of her March 30, 2016 admission. *Id.* at 165-66. Her hypercoagulable studies, which were done to check whether she had a condition predisposing her to blood clots, were also normal. *Id.* at 166.

On cross examination, Dr. Messé maintained that Petitioner's smoking habit was another likely risk factor for stroke, despite her relatively young age. Tr. at 178. He explained that smoking increases the risks of atherosclerosis and blood clots. *Id.* at 179.

Dr. Messé testified that flu infection can contribute to stroke risk, in part due to inflammation. Tr. at 182, 194. He agreed that inflammation plays a role in stroke and that the Smeeth study was at least indirectly looking at the association between inflammatory conditions and stroke. *Id.* at 181. He opined that strokes caused by a recent or ongoing inflammatory state are "rare." *Id.* at 221.

Dr. Messé acknowledged that in the Smeeth study, more than 170 subjects experienced a stroke within a week of receiving a flu vaccination. Tr. at 181. In his view, this was coincidental, but he conceded that these cases were not assessed individually. *Id.* at 182. He further agreed that the study was not powered to detect rare adverse events. *Id.* at 192. He pointed out, however, that the risk of stroke was most reduced in the first one to three days following flu vaccination; he surmised that this could be because people receiving the flu vaccination tend to be healthier. *Id.* at 222-23.

Dr. Messé disagreed with Dr. Boylan's opinion that, if a wild-type infection has been associated with a harm, it is reasonable to presume that vaccination against that infection could cause the same harm. Tr. at 189. He explained that the body's responses to infection and vaccination are "different in severity and extent." *Id.* at 190. He generally agreed, however, that "immune system activation" can contribute to stroke risk and that vaccination is specifically designed to activate the immune system. *Id.* at 191-92.

Regarding Petitioner's second episode, Dr. Messé testified that there was some uncertainty whether she suffered a second acute stroke caused by her carotid web or a vascular event due to the June 24, 2016 angiogram procedure. Tr. at 204-05. He favored the procedure as the precipitating event, in agreement with Dr. Boylan. *Id.* at 205.

Dr. Messé agreed that a carotid web is a preexisting thrombotic condition, but he distinguished that from a hypercoagulable state or a generalized prothrombotic state. Tr. at 206-07. He explained that the web increases the likelihood of developing a clot in the web's location, not elsewhere the body. *Id.* at 207. He allowed that recurrent strokes are seen in patients with carotid webs, but he disagreed that the presence of a web would guarantee recurrent strokes. Tr. at 214-15. Instead, he opined that carotid web is a meaningful risk factor for stroke. *Id.* at 215.

Regarding Petitioner's presentation at the time of her first stroke, Dr. Messé agreed that her CRP level might have been normal even in the presence of inflammation. Tr. at 219. However, he maintained that there was no evidence of inflammation in Petitioner's case. *Id.* He testified that for "a systemic inflammatory state that's bad enough to cause a stroke, I would expect to see something." *Id.* at 220.

Dr. Messé testified that the timing of Petitioner's initial stroke fell within the range during which the risk of stroke is increased due to the body's "inflammatory and immunological ramp-up responding to infection." Tr. at 212. But he pointed out that her stroke also occurred in the timeframe "where we saw a reduced risk of stroke in people who are vaccinated." *Id.* at 212-13.

IV. LEGAL FRAMEWORK

A. Petitioner's Burden in Vaccine Program Cases

Under the Vaccine Act, a petitioner may prevail in one of two ways. First, a petitioner may demonstrate that she suffered a "Table" injury—i.e., an injury listed on the Vaccine Injury Table—that occurred within the time provided in the Table. § 11(c)(1)(C)(i). "In such a case, causation is presumed." *Capizzano v. Sec'y of Health & Hum. Servs.*, 440 F.3d 1317, 1320 (Fed. Cir. 2006); *see* § 13(a)(1)(B). Second, where the alleged injury is not listed in the Vaccine Injury Table, a petitioner may demonstrate that she suffered an "off-Table" injury caused by the vaccination. § 11(c)(1)(C)(ii).

For both Table and non-Table claims, Vaccine Program petitioners bear a "preponderance of the evidence" burden of proof. § 13(a)(1). That is, a petitioner must offer evidence that leads the "trier of fact to believe that the existence of a fact is more probable than its nonexistence before [he] may find in favor of the party who has the burden to persuade the judge of the fact's existence." *Moberly v. Sec'y of Health & Hum. Servs.*, 592 F.3d 1315, 1322 (Fed. Cir. 2010); *see also Snowbank Enter. v. United States*, 6 Cl. Ct. 476, 486 (1984) (mere conjecture or speculation is insufficient under a preponderance standard). The petitioner must demonstrate that the vaccine was "not only [the] but-for cause of the injury but also a substantial factor in bringing about the injury." *Moberly*, 592 F.3d at 1321 (quoting *Shyface v. Sec'y of Health & Hum. Servs.*, 165 F.3d 1344, 1352-53 (Fed. Cir. 1999)); *Pafford v. Sec'y of Health & Hum. Servs.*, 451 F.3d 1352, 1355 (Fed. Cir. 2006). A petitioner may not receive a Vaccine Program award based solely on her own assertions; rather, the petition must be supported by either medical records or the opinion of a competent physician. § 13(a)(1).

To establish entitlement to a Vaccine Program award of compensation for a non-Table claim, a petitioner must satisfy all three of the elements established by the Federal Circuit in *Althen v. Secretary of Health and Human Services*, 418 F.3d 1274 (Fed. Cir. 2005). *Althen* requires a petitioner to establish by preponderant evidence that the vaccination she received caused her injury "by providing: (1) a medical theory causally connecting the vaccination and the injury; (2) a logical sequence of cause and effect showing that the vaccination was the reason for the injury; and (3) a showing of a proximate temporal relationship between vaccination and injury." *Id.* at 1278.

Each of the *Althen* prongs requires a different showing. Under *Althen* prong one, petitioner must provide a "reputable medical theory," demonstrating that the vaccine received *can cause* the type of injury alleged. *Pafford*, 451 F.3d at 1355-56 (citations omitted). To satisfy this prong, a petitioner's theory must be based on a "sound and reliable medical or scientific explanation." *Knudsen v. Sec'y of Health & Hum. Servs*., 35 F.3d 543, 548-49 (Fed. Cir. 1994). Such a theory must only be "legally probable, not medically or scientifically certain." *Id.* at 549; *Bunting v. Sec'y of Health & Hum. Servs.*, 931 F.2d 867, 873 (Fed. Cir. 1991) (proof of medical certainty is not required).

Petitioner may satisfy the first *Althen* prong without resort to medical literature, epidemiological studies, demonstration of a specific mechanism, or presentation of a generally accepted medical theory. *Andreu v. Sec'y of Health & Hum. Servs.*, 569 F.3d 1367, 1378-79 (Fed.

Cir. 2009) (citing *Capizzano*, 440 F.3d at 1325-26). Special masters, despite their expertise, are not empowered by statute to conclusively resolve what are complex scientific and medical questions, and thus the scientific evidence offered to establish *Althen* prong one is viewed "not through the lens of the laboratorian, but instead from the vantage point of the Vaccine Act's preponderant evidence standard." *Id.* at 1380. Special masters must take care not to increase the burden placed on petitioners in offering a scientific theory linking vaccine to injury, but this does not negate or reduce a petitioner's ultimate burden to establish her overall entitlement to damages by preponderant evidence. *W.C. v. Sec'y of Health & Hum. Servs*., 704 F.3d 1352, 1356 (Fed. Cir. 2013) (citations omitted).

The second *Althen* prong requires proof of a logical sequence of cause and effect, usually supported by facts derived from a petitioner's medical records. *Althen*, 418 F.3d at 1278; *Andreu*, 569 F.3d at 1375-77; *Capizzano*, 440 F.3d at 1326 ("medical records and medical opinion testimony are favored in vaccine cases, as treating physicians are likely to be in the best position to determine whether a 'logical sequence of cause and effect show[s] that the vaccination was the reason for the injury'") (quoting *Althen*, 418 F.3d at 1278). Medical records are generally viewed as particularly trustworthy evidence, because they are created contemporaneously with the treatment of the patient. *Cucuras v. Sec'y of Health & Hum. Servs.*, 993 F.2d 1525, 1528 (Fed. Cir. 1993). However, medical records and/or statements of a treating physician's views do not *per se* bind the special master to adopt the conclusions of such an individual, even if they must be considered and carefully evaluated. § 13(b)(1) (providing that "[a]ny such diagnosis, conclusion, judgment, test result, report, or summary shall not be binding on the special master or court"); *Snyder v. Sec'y of Health & Hum. Servs*., 88 Fed. Cl. 706, 746 n.67 (2009) ("there is nothing … that mandates that the testimony of a treating physician is sacrosanct–- that it must be accepted in its entirety and cannot be rebutted"). As with expert testimony offered to establish a theory of causation, the opinions or diagnoses of treating physicians are only as trustworthy as the reasonableness of their suppositions or bases. The views of treating physicians should also be weighed against other, contrary evidence also present in the record -- including conflicting opinions among such individuals. *Hibbard v. Sec'y of Health & Hum. Servs*., 100 Fed. Cl. 742, 749 (2011) (not arbitrary or capricious for special master to weigh competing treating physicians' conclusions against each other), *aff'd*, 698 F.3d 1355 (Fed. Cir. 2012); *Veryzer v. Sec'y of Health & Hum. Servs*., No. 06-522V, 2011 WL 1935813 at *17 (Fed. Cl. Spec. Mstr. Apr. 29, 2011), *mot. for review den'd*, 100 Fed. Cl. 344, 356 (2011), *aff'd without opinion*, 475 Fed. App'x. 765 (Fed. Cir. 2012).

The third *Althen* prong requires establishing a "proximate temporal relationship" between the vaccination and the injury alleged. *Althen*, 418 F.3d at 1278. That term has been equated to the phrase "medically acceptable temporal relationship." *Id.* at 1281. A petitioner must offer "preponderant proof that the onset of symptoms occurred within a timeframe which, given the medical understanding of the disorder's etiology, it is medically acceptable to infer causation." *de Bazan v. Sec'y of Health & Hum. Servs*., 539 F.3d 1347, 1352 (Fed. Cir. 2008). The explanation for what is a medically acceptable timeframe must also coincide with the theory of how the relevant vaccine can cause an injury (*Althen* prong one's requirement). *Id.* at 1352; *Shapiro v. Sec'y of Health & Hum. Servs*., 101 Fed. Cl. 532, 542 (2011), *recons. den'd after remand on other grounds*, 105 Fed. Cl. 353 (2012), *aff'd without op.,* 503 F. App'x. 952 (Fed. Cir. 2013); *Koehn v. Sec'y of Health & Hum. Servs*., No. 11-355V, 2013 WL 3214877 (Fed. Cl. Spec. Mstr. May 30, 2013),

mot. for review den'd, 113 Fed. Cl. 757 (Fed. Cl. Dec. 3, 2013), *aff'd*, 773 F.3d 1239 (Fed. Cir. 2014).

B. Law Governing Analysis of Fact Evidence

The process for making factual determinations in Vaccine Program cases begins with analyzing the medical records, which are required to be filed with the petition. § 11(c)(2). The special master is required to consider "all [] relevant medical and scientific evidence contained in the record." § 13(b)(1)(A). This includes "any diagnosis, conclusion, medical judgment, or autopsy or coroner's report which is contained in the record regarding the nature, causation, and aggravation of the petitioner's illness, disability, injury, condition, or death," and the "results of any diagnostic or evaluative test which are contained in the record and the summaries and conclusions." *Id.* The special master is then required to weigh the evidence presented, including contemporaneous medical records and testimony. *See Burns v. Sec'y of Health & Hum. Servs*., 3 F.3d 415, 417 (Fed. Cir. 1993) (it is within the special master's discretion to determine whether to afford greater weight to contemporaneous medical records than to other evidence, such as oral testimony surrounding the events in question that was given at a later date, provided that such determination is evidenced by a rational determination).

Medical records created contemporaneously with the events they describe are generally trustworthy, because they "contain information supplied to or by health professionals to facilitate diagnosis and treatment of medical conditions," where "accuracy has an extra premium." *Kirby v. Sec'y of Health & Hum. Servs.*, 997 F.3d 1378, 1382 (Fed. Cir. 2021) (citing *Cucuras*, 993 F.2d at 1528). Accordingly, if the medical records are clear, consistent, and complete, then they should be afforded substantial weight. *See generally Lowrie v. Sec'y of Health & Hum. Servs.*, No. 03-1585V, 2005 WL 6117475 at *20 (Fed. Cl. Spec. Mstr. Dec. 12, 2005). Indeed, contemporaneous medical records are often found to be deserving of greater evidentiary weight than oral testimony–- especially where such testimony conflicts with the record evidence. *Cucuras*, 993 F.2d at 1528; *see also Murphy v. Sec'y of Health & Hum. Servs.*, 23 Cl. Ct. 726, 733 (1991), *aff'd per curiam*, 968 F.2d 1226 (Fed. Cir. 1992), *cert. den'd, Murphy v. Sullivan*, 506 U.S. 974 (1992) (citing *United States v. U.S. Gypsum Co.*, 333 U.S. 364, 396 (1947) ("[i]t has generally been held that oral testimony which is in conflict with contemporaneous documents is entitled to little evidentiary weight.")).

However, there are situations in which compelling oral testimony may be more persuasive than written records, such as where records are deemed to be incomplete or inaccurate. *Campbell v. Sec'y of Health & Hum. Servs.*, 69 Fed. Cl. 775, 779 (2006) ("like any norm based upon common sense and experience, this rule should not be treated as an absolute and must yield where the factual predicates for its application are weak or lacking"); *Lowrie*, 2005 WL 6117475 at *19 ("[w]ritten records which are, themselves, inconsistent, should be accorded less deference than those which are internally consistent") (quoting *Murphy*, 23 Cl. Ct. at 733)). Ultimately, a determination regarding a witness's credibility is needed when determining the weight that such testimony should be afforded. *Andreu*, 569 F.3d at 1379; *Bradley v. Sec'y of Health & Hum. Servs.*, 991 F.2d 1570, 1575 (Fed. Cir. 1993).

In determining the accuracy and completeness of medical records, the Court of Federal

Claims has listed four possible explanations for inconsistencies between contemporaneously created medical records and later testimony: (1) a person's failure to recount to the medical professional everything that happened during the relevant time period; (2) the medical professional's failure to document everything reported to her or him; (3) a person's faulty recollection of the events when presenting testimony; or (4) a person's purposeful recounting of symptoms that did not exist. *LaLonde v. Sec'y of Health & Hum. Servs.*, 110 Fed. Cl. 184, 203-04 (2013), *aff'd*, 746 F.3d 1334 (Fed. Cir. 2014). In deciding whether to afford greater weight to contemporaneous medical records or other evidence, such as testimony, a rational analysis must be explicated. *Burns*, 3 F.3d at 417.

C. Analysis of Expert Testimony

Establishing a sound and reliable medical theory connecting the vaccine to the injury often requires a petitioner to present expert testimony in support of his or her claim. *Lampe v. Sec'y of Health & Hum. Servs.*, 219 F.3d 1357, 1361 (Fed. Cir. 2000). Vaccine Program expert testimony is usually evaluated according to the factors for analyzing scientific reliability set forth in *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 594-96 (1993). *See Cedillo v. Sec'y of Health & Hum. Servs.*, 617 F.3d 1328, 1339 (Fed. Cir. 2010) (*citing Terran v. Sec'y of Health & Hum. Servs.*, 195 F.3d 1302, 1316 (Fed. Cir. 1999)). "The *Daubert* factors for analyzing the reliability of testimony are: (1) whether a theory or technique can be (and has been) tested; (2) whether the theory or technique has been subjected to peer review and publication; (3) whether there is a known or potential rate of error and whether there are standards for controlling the error; and (4) whether the theory or technique enjoys general acceptance within a relevant scientific community." *Terran*, 195 F.3d at 1316 n.2 (citing *Daubert*, 509 U.S. at 592-95).

The *Daubert* factors play a slightly different role in Vaccine Program cases than in other federal judicial proceedings. Those factors are employed by judges to exclude evidence that is unreliable and potentially confusing to a jury. In Vaccine Program cases, the factors are used in the weighing of the reliability of scientific evidence. *Davis v. Sec'y of Health & Hum. Servs.*, 94 Fed. Cl. 53, 66-67 (2010) ("uniquely in this Circuit, the *Daubert* factors have been employed also as an acceptable evidentiary-gauging tool with respect to persuasiveness of expert testimony already admitted"). The flexible use of the *Daubert* factors to evaluate persuasiveness and reliability of expert testimony has routinely been upheld. *See, e.g., Snyder*, 88 Fed. Cl. at 743. In this matter (as in numerous other Vaccine Program cases), *Daubert* has not been employed at the threshold to determine what evidence should be admitted, but instead to determine whether expert testimony offered is reliable and/or persuasive.

Respondent frequently offers one or more experts of his own to rebut a petitioner's case. Where both sides offer expert testimony, a special master's decision may be "based on the credibility of the experts and the relative persuasiveness of their competing theories." *Broekelschen v. Sec'y of Health & Hum. Servs.*, 618 F.3d 1339, 1347 (Fed. Cir. 2010) (citing *Lampe*, 219 F.3d at 1362). Nothing requires the acceptance of an expert's conclusion "connected to existing data only by the *ipse dixit* of the expert," especially if "there is simply too great an analytical gap between the data and the opinion proffered." *Snyder*, 88 Fed. Cl. at 743 (quoting *Gen. Elec. Co. v. Joiner*, 522 U.S. 136, 146 (1997)). A "special master is entitled to require some indicia of reliability to support the assertion of the expert witness." *Moberly*, 592 F.3d at 1324.

Weighing the relative persuasiveness of competing expert testimony, based on a particular expert's credibility, is part of the overall reliability analysis to which special masters must subject expert testimony in Vaccine Program cases. *Id.* at 1325-26 ("[a]ssessments as to the reliability of expert testimony often turn on credibility determinations"); *see also Porter v. Sec'y of Health & Hum. Servs.*, 663 F.3d 1242, 1250 (Fed. Cir. 2011) ("this court has unambiguously explained that special masters are expected to consider the credibility of expert witnesses in evaluating petitions for compensation under the Vaccine Act").

D. Consideration of Medical Literature

Finally, although this decision discusses some but not all the record evidence in detail, I have reviewed and considered all the materials submitted in this matter. *See Moriarty v. Sec'y of Health & Hum. Servs.*, 844 F.3d 1322, 1328 (Fed. Cir. 2016) ("We generally presume that a special master considered the relevant record evidence even though [s]he does not explicitly reference such evidence in h[er] decision."); *Simanski v. Sec'y of Health & Hum. Servs.*, 115 Fed. Cl. 407, 436 (2014) ("[A] Special Master is 'not required to discuss every piece of evidence or testimony in her decision.'" (citation omitted)), *aff'd*, 601 F. App'x. 982 (Fed. Cir. 2015).

V. ANALYSIS

A. Diagnosis

Initially, it is important to clarify some areas of agreement between the parties concerning Petitioner's condition. Drs. Boylan and Messé agreed that Petitioner suffered an ischemic stroke on March 30, 2016. First Boylan Rep. at 5; Messé Rep. at 4. They further agreed that she suffered a stroke in late June 2016, which was either a new stroke or a continuation/expansion of the first stroke. *Id*. Neither expert felt that the June 2016 stroke was a direct result of the March 22, 2016 flu vaccination. Instead, they concurred that the second stroke was likely triggered by the cerebral angiogram Petitioner underwent on June 24, 2016, because stroke is a known risk of that procedure.[11] First Boylan Rep. at 5; Messé Rep. at 4-5; Tr. at 87, 207.

The operative question to resolve, then, is whether Petitioner's first stroke on March 30, 2016, was caused by the subject flu vaccination.

B. *Althen* Prong One

1. Causation Theory

Petitioner has asserted an off-Table claim and thus must prove by preponderant evidence that she suffered an injury caused by the vaccination at issue, satisfying all of the *Althen* prongs. *See Capizzano*, 440 F.3d at 1320. Under *Althen* prong one, Petitioner must provide a reputable, sound, and reliable medical theory that the vaccine can cause the injury. *Boatmon v. Sec'y of*

[11] There also appears to be no dispute that the cerebral angiogram was necessitated by the first stroke. After that event, Petitioner continued being seen by neurologist Dr. El-Gengaihy, who ordered the angiogram. *See* Ex. 10 at 10.

Health & Hum. Servs., 941 F.3d 1351, 1359 (Fed. Cir. 2013). "[T]o establish causation, the standard of proof is preponderance of evidence, not scientific certainty." *Langland v. Sec'y of Health & Hum. Serv.*, 109 Fed. Cl. 421, 441 (2013).

Petitioner's theory of causation centers on the interaction of the inflammatory response elicited by flu vaccination with a preexisting prothrombotic condition -- in this case, a carotid web. Dr. Boylan opined that this combination of factors can lead to clot formation and embolization, causing stroke. *See* Tr. at 94.

Petitioner provided some support for the proposition that inflammation, including from an acute infection, can play a role in stroke. Dr. Boylan testified that patients with acute, severe systemic illnesses, such as sepsis, are at higher risk of stroke. Tr. at 34-35. The more inflammation a person experiences, the worse the outcome of a stroke might be. *Id.* at 50. Medications with anti-inflammatory properties are given to treat strokes. *Id.*

Dr. Boylan cited to some medical literature that purports to support her theory. In Smeeth, an increased risk of stroke was found across the first 90 days following diagnosis of a systemic respiratory infection, with the highest risk during the first three days. Smeeth at 2614. In the Esenwa review, the authors stated that proinflammatory conditions, "including acute and chronic infections," are associated with an increased risk of stroke. Esenwa CC, et al., *Inflammatory risk factors, biomarkers and associated therapy in ischaemic stroke*, NATURE REVIEWS (NEUROLOGY) (2016);12:594-604 (Ex. 42) ("Esenwa") at 594. Moreover, the enhanced risk appears to be temporally related to the inflammation produced by those conditions. *Id*. at 595. Esenwa discussed studies reporting that the risk of stroke was associated with elevated levels of several inflammatory markers, including CRP and IL-6.[12] *Id.* at 597. The authors posited that the innate immune system shares targets with the coagulation system, "with the potential to induce a hypercoagulable state whenever the system is acutely activated." *Id.* at 602.

Likewise, the McColl review reported that inflammation, including that produced by infection, is implicated in "multiple phases of stroke etiology and pathology." McColl at 1. Discussing infections generally, the authors noted that "numerous clinical studies have suggested a link between peripheral infection and increased stroke susceptibility and recent data have provided compelling evidence to support these earlier studies." *Id.* at 2. The Murray review reported similar observations, concluding that "stroke risk and outcome can be modified by a pre-existing inflammatory burden, be it from chronic disease or acute infection." Murray KN, et al., *Systemic immune activation shapes stroke outcome*, MOLECULAR AND CELLULAR NEUROSCIENCE (2013);14-25 (Ex. 28) ("Murray") at 22. Cardenas proposed that neuroinflammation could result from vaccination or infection; through a literature review, the authors identified seven cases of stroke following H1N1 flu vaccination. Cardenas at 340, 343.

[12] Interleukin-6: a lymphokine produced by antigen- or mitogen-activated T cells, fibroblasts, macrophages, and adipose and other cells that serves as a differentiation factor for B cells and thymocytes and stimulates immunoglobulin production by B cells; it also induces hepatocytes to synthesize various plasma proteins involved in the acute phase response and is a cofactor in initiation of the cell cycle in primitive hematopoietic cells in vitro. Interleukin-6, DORLAND'S, https://www.dorlandsonline.com/dorland/definition?id=83023 (last accessed on December 31, 2024).

It is not enough, however, to point to an association between stroke and inflammation without providing some evidence characterizing the inflammatory properties of the subject vaccine. On cross, Dr. Boylan acknowledged that "not every inflammation will provoke a stroke, and not every stroke will be caused by inflammation[.]" Tr. at 39. She further conceded that strokes after vaccination are coincidental "in most cases." *See id.* at 104-06. She admitted that inflammatory triggers like bee stings, seasonal allergies, and poison ivy are not associated with stroke. *Id.* at 104-05; *see also id.* at 180, 221 (Dr. Messé stating that, although inflammation plays a role in stroke, it is "rare" to see a stroke caused by an acute inflammatory condition). She also admitted that the immune response to a natural flu infection would be more inflammatory than the response to a vaccine. *Id.* at 103.

Notably, Petitioner failed to provide any evidence of the type, quantity, or duration of the inflammatory products of the flu vaccine. None of the submitted literature addresses this question. Dr. Boylan testified that inflammation affects the endothelium in the blood vessels, impairing the ability of the vessels to relax, which in turn causes dysfunction of blood flow, inducing clotting. Tr. at 53-54. She attempted to tie this to the flu vaccine, but her testimony on this point was unpersuasive. Discussing Smeeth, she referenced a different study (the Hingorani paper, cited below), which she said involved healthy individuals who were given the flu vaccine and experienced inflammation that suppressed endothelium-dependent relaxation for "two weeks after the vaccination." *Id.* at 54. However, Dr. Boylan incorrectly recited Smeeth's description of the Hingorani study: the Smeeth authors simply reported that "in an experimental model, the vaccination of healthy volunteers induced a short-lived inflammation that was associated with profound suppression of endothelium-dependent relaxation." Smeeth at 2612. In fact, the Hingorani study, which was submitted into evidence after the hearing, did not investigate endothelium-dependent relaxation following flu vaccination. Instead, it tested the inflammatory effects of the *Salmonella typhi* vaccine and found that the inflammatory markers returned to normal within 32 hours after that vaccination. Hingorani AD, et al., *Acute Systemic Inflammation Impairs Endothelium-Dependent Dilatation in Humans*, CIRCULATION (2000);994-999 (Ex. C) ("Hingorani") at 997; *see* Resp't's Post-Hr'g Br. at 6-7. Thus, it appears that Dr. Boylan's testimony on this topic was erroneous, weakening her opinion.[13]

2. "Booster effect" of repeated vaccinations

Pointing to the fact that Petitioner received a flu vaccination six months before the subject vaccination, Dr. Boylan opined that repeated flu vaccinations might produce a "booster effect" that amplified Petitioner's inflammatory response and the risk of stroke. *See* Tr. at 92-93. But Dr. Boylan admittedly had no evidence supporting this proposition. *Id.* at 93. No literature was provided. Instead, she relied on the fact that, in her personal experience, COVID-19 vaccine recipients have experienced strong reactions to second doses of that vaccine. *Id.* at 92-93. Her testimony on this question was unpersuasive.

[13] Even accepting that the Hingorani study did show a transient effect of vaccination on endothelium-dependent relaxation of the vessels, Smeeth found a significantly reduced risk of stroke during the period of inflammatory response for flu vaccination. Smeeth at 2615 (Table 1) (reporting a 23% reduction in stroke risk in the first three days after flu vaccination, a 28% reduction in risk from days 4-7, and a 16% reduction in risk from days 8-14).

When given the opportunity to submit additional evidence after the entitlement hearing, Petitioner filed a printout of a CDC webpage entitled "Children, the Flu, and the Flu Vaccine," which reported that children between six months and eight years old require two doses of the influenza vaccine to receive full protection. Ex. 41 at 1-2. On the same webpage, though, the CDC stated that "[d]ifferent products are approved for different age groups, including children as young as 6 months of age." *Id.* at 1. In other words, childhood vaccines are typically formulated differently from those for adults. Further, this site provides no evidence that a second dose of flu vaccine in anyone amplifies the inflammatory response. This reference does not support Dr. Boylan's claim about a "booster effect" in this case, nor has Petitioner submitted any other evidence to support this opinion.

3. Interaction between flu vaccination and carotid webs

Dr. Boylan further opined that flu vaccination can cause stroke in a person with a carotid web. She hypothesized that the inflammation elicited by the vaccine can exacerbate thrombosis in the carotid artery, leading to clotting, embolization, and stroke. Tr. at 94.

There was some disagreement among Petitioner's treating physicians about whether the appropriate diagnosis was carotid web or an ulcerated atherosclerotic plaque in the left carotid artery. *Compare* Ex. 6 at 230 *with* Ex. 15 at 473, 673-77. Dr. Messé initially interpreted the imaging to show an ulcerated plaque. Messé Rep. at 4. Ultimately, though, both parties' experts agreed Petitioner had a carotid web, a conclusion that is supported by the medical records. Tr. at 64, 158-59.

The experts concurred that carotid web is associated with an increased risk of stroke, due to a heightened tendency toward thrombosis. Tr. at 78-79, 83, 161. This proposition is uniformly supported by the literature. *See* Choi PMC, et al., *Carotid Webs and Recurrent Ischemic Strokes in the Era of CT Angiography*, AM. J. NEURORADIOL. (2015);36:2134-2139 (Ex. 21) ("Choi") at 2134 (surmising that carotid web contributes to stroke due to impaired blood flow and thrombogenicity); Haussen DC, et al., *Carotid Web (Intimal Fibromuscular Dysplasia) Has High Stroke Recurrence Risk and Is Amenable to Stenting*, STROKE (2017);48:1-4 (Ex. 24) ("Haussen") at 1 (reporting an association between carotid web and high risk of recurrent stroke/TIA; carotid webs are "high-risk lesions," likely due to a causing a predisposition to thromboembolism); Sajedi PI, et al., *Carotid Bulb Webs as a Cause of "Cryptogenic" Ischemic Stroke*, AM. J. NEURORADIOL. (2017);38:1399-1404 (Ex. 29) ("Sajedi") at 1399 (study finding a statistically significant association between cryptogenic stroke and carotid web).[14] Similar to other parts of her theory, though, Dr. Boylan failed to submit any supportive evidence illustrating how the flu vaccine could produce a stroke in a person with this condition. She did not present any clinical or other data concerning the putative interaction of vaccination, carotid web, and stroke. None of the literature on carotid web and stroke hypothesized that any type of vaccination could exacerbate the risk. *See generally* Choi, Haussen, Sajedi.

[14] As Dr. Messé clarified, although a carotid web predisposes one to thrombosis in the location of the web, that condition does not equate to a generalized prothrombotic state. Tr. at 206-07.

Dr. Boylan also suggested that a carotid web in someone Petitioner's age would not itself be sufficient to cause a stroke. Tr. at 91. Instead, a catalyst, such as the inflammation produced by a vaccination, would be needed. *Id.* But the literature she submitted identified carotid web as an independent risk factor for stroke in Petitioner's age group. The authors in Choi, for example, concluded that "[t]he carotid web may be an important cause of ischemic stroke in patients with otherwise no determined mechanism of stroke and present a high risk of recurrent stroke." Choi at 2138; *see also* Haussen at 1 ("Carotid web is associated with high recurrent stroke/TIA risk, despite antithrombotic use"); Sajedi at 1399 (noting that "carotid webs exhibit a strong association with ischemic stroke, and their presence should be suspected in patients lacking other risk factors, particularly African American women").

4. Epidemiologic Data

Epidemiologic evidence is not required to prove a Vaccine Act case. It is appropriate, however, for a special master to consider such evidence as part of the overall assessment of the case. *See Druery v. Sec'y of Health & Hum. Servs.*, No. 17-1213V, 2023 WL 5094088, at *17 (Fed. Cl. July 11, 2023), *mot. for rev. den'd*, 169 Fed. Cl. 557 (2024) (observing that "[n]othing in *Althen* or *Capizzano* requires the Special Master to ignore probative epidemiological evidence that undermines petitioner's theory.") (quoting *D'Tiole v. Sec'y of Health & Hum. Servs.*, 726 F. App'x. 809, 811 (Fed. Cir. 2018)). "Although *Althen* and *Capizzano* make clear that a claimant need not produce medical literature or epidemiological evidence to establish causation under the Vaccine Act, where such evidence is submitted, the Special Master can consider it in reaching an informed judgment as to whether a particular vaccination likely caused a particular injury." *Andreu*, 569 F.3d at 1379.

The epidemiologic literature in the record strongly indicates that flu vaccination is associated with a reduced, not increased, risk of stroke. The Smeeth study, which included more than 19,000 flu-vaccinated patients, found that there was no increase in the rate of stroke during the first 90 days following vaccination, compared to the baseline period.[15] Smeeth at 2614-15. Moreover, as Dr. Messé explained, the study found a significantly *reduced* risk of stroke during the first 28 days following flu vaccination. Tr. at 172; *see also* Smeeth at 2615 (Table 1) (reporting significantly decreased risks of stroke at 1-3 days, 4-7 days, 8-14 days, and 15-28 days after flu vaccination). Petitioner's stroke occurred during this initial timeframe. Notably, Dr. Boylan did not question the Smeeth study's methodology, and she agreed with the authors' finding that the vaccine is not associated with an increased stroke risk at the population level. *Id.* at 97-98.

In the Siriwardena study, the authors compared stroke patients to controls to assess the potential association between flu vaccination and stroke. Siriwardena at 1354. The study reported that flu-vaccinated patients had a 24% reduction in the risk of stroke compared to unvaccinated

[15] For the flu-vaccinated participants in Smeeth, the baseline period for assessing the risk of stroke did not include any time preceding a first flu vaccination. This is because one of the indications for receiving the flu vaccination is preexisting cardiovascular disease; thus, the receipt of a flu vaccination is "itself associated with the risk of vascular events." Smeeth at 2613. The authors explained that "[t]o ensure that during the observation period there was minimal variation in the opportunity to be vaccinated, the observation period used in the analysis with regard to influenza vaccination did not include the time before a participant's first influenza vaccination." *Id.*

patients. *Id.* at 1354, 1358 (Table 3). Dr. Messé testified that this study was "well done" and was "very reassuring that there's no association at all with stroke risk." Tr. at 174. The Grau study similarly found that the risk of stroke following flu vaccination was reduced compared to the risk in unvaccinated controls. Grau at 1501. Dr. Boylan did not dispute the methodologies or findings of these studies.

Dr. Boylan referenced the Lin case report as a clinical example of the possibility that a flu vaccine can trigger stroke. Lin at 345. Lin described a 75-year-old patient who suffered an ischemic stroke the same day as an influenza A/H1N1 vaccination. *Id.* at 345-346. Lin is distinguishable in several ways from this case. The patient was substantially older than Petitioner, had suffered a previous stroke, and had several comorbidities. *Id*. The other case report produced by Petitioner, Wirrell, is also distinguishable, as it described strokes following varicella vaccinations in two children. Wirrell E, et al., *Stroke After Varicella Vaccination*, J PEDIATR (2004);145:845-47 (Ex. 33) ("Wirrell") at 845. Furthermore, case reports are inferior scientific evidence of causation and generally do not, on their own, support a causal attribution. *See, e.g.*, *R.V. v. Sec'y of Health & Hum. Servs.*, No. 11-504V, 2016 WL 3882519, *41 (Fed. Cl. Spec. Mstr. Feb. 19, 2016) (noting that "individual patient case reports . . . are not in general, strong evidence of causation") (internal quotation marks omitted)), *mot. for rev. den'd*, 127 Fed. Cl. 136 (2016).

Overall, I conclude that Petitioner failed to produce preponderant evidence of a sound, reliable theory demonstrating how the flu vaccine is capable of causing stroke. Instead, she offered disjointed evidence of risk factors for stroke, without evidence tying them to the properties of the flu vaccine, with respect to which the epidemiologic data is reassuring. *Althen* prong one was not satisfied.

C. *Althen* Prong Two

Under *Althen's* second prong, a petitioner must "prove a logical sequence of cause and effect showing that the vaccination was the reason for the injury." *Althen*, 418 F.3d at 1278. The sequence of cause and effect must be "'logical' and legally probable, not medically or scientifically certain." *Id.* A petitioner is not required to show "epidemiologic studies, rechallenge, the presence of pathological markers or genetic disposition, or general acceptance in the scientific or medical communities to establish a logical sequence of cause and effect." *Id.* (omitting internal citations); *Capizzano v. Sec'y of Health & Hum. Servs*., 440 F.3d 1317, 1325 (Fed. Cir. 2006). Instead, circumstantial evidence and reliable medical opinions may be sufficient to satisfy the second *Althen* prong. *Isaac v. Sec'y of Health & Hum. Servs*., No. 08-601V, 2012 WL 3609993, at *24 (Fed. Cl. Spec. Mstr. July 30, 2012), *mot. for rev. den'd*, 108 Fed. Cl. 743 (2013), *aff'd*, 540 F. App'x. 999 (Fed. Cir. 2013).

I conclude that Petitioner has not demonstrated a logical sequence of cause and effect between her March 22, 2016 flu vaccination and her initial stroke on March 30, 2016. Initially, it is undisputed that, although Petitioner was diagnosed and treated by a number of specialists, including several neurologists, no treating physician attributed her stroke to her flu vaccination. Dr. Boylan acknowledged this. Tr. at 106. Moreover, the contemporaneous medical records do not indicate that Petitioner suffered a significant inflammatory response to the vaccination, as would be expected under Dr. Boylan's mechanistic theory. *See id.* at 220 (Dr. Messé testifying

that for "a systemic inflammatory state that's bad enough to cause a stroke, I would expect to see something."); *see also Hibbard v. Sec'y of Health & Hum. Servs.*, No. 07-446V, 2011 WL 1766033, at *9 (Fed. Cl. Spec. Mstr. Apr. 12, 2011) (finding *Althen* prong two unsatisfied where the petitioner failed to prove her injury was consistent with the mechanistic theory of vaccine causation she advanced), *mot. for rev. den'd*, 100 Fed. Cl. 742, 749 (2011), *aff'd*, 698 F.3d 1355 (Fed. Cir. 2012).

During the eight days between the vaccination and Petitioner's stroke, she made no complaints to any medical providers of symptoms that might be indicative of inflammation, such as fever, rash, edema, bruising, or purpura, which are common post-vaccination reactions.[16] Likewise, when she went to the hospital on March 30, 2016, the records show she did not report recently feeling unwell. To the contrary, she reported being in "good chronic health" and that "[p]rior to her ER visit she was in her usual state of health."[17] Ex. 6 at 220, 224. She underwent multiple examinations at the hospital, with no observations of clinical signs of inflammation. *See id.* at 222 (admission exam on March 30, 2016, finding no signs of skin abnormalities or rash); *id.* at 281 (March 30, 2016 ER exam showing no evidence of fever, rash, or impaired range of motion). Lab work done in the hospital showed normal levels of inflammatory markers such as CRP and ESR, as well as a negative hypercoagulable workup, signifying that she did not have a blood condition predisposing her to thrombosis.[18] *Id.* at 342, 344-48, 349, 350; Tr. at 165-66. There are some records in which Petitioner reported having some continuing left-arm soreness/tightness in the weeks after her stroke, but the most contemporaneous records – those from her initial presentation to the hospital – consistently reflected no complaints or findings indicative of inflammation before or at the time of the stroke. *See* Tr. at 121-23; Ex. 6 at 594; Ex. 10 at 5. Her VAERS report also failed to mention any symptoms consistent with inflammation in the days between the vaccination and the stroke. Ex. 3.

At the hearing, Petitioner testified that she experienced left arm redness, swelling, and soreness for a "couple months" after vaccination. Tr. at 7. This testimony contravened her earlier sworn statement in this litigation, where she stated that her left arm was "sore and pink" for a few days after the vaccination, but those symptoms lessened over the next week. Ex. 1 at 2. I do not find Petitioner's testimony on this subject persuasive, particularly given her admitted memory problems since her stroke, and it is insufficient to overcome the contemporaneous medical records. *See* Tr. at 14; *Cucuras*, 993 F.2d at 1528.

[16] CDC, *Possible Side Effects from Vaccines*, https://www.cdc.gov/vaccines/basics/possible-side-effects.html (last accessed on January 6, 2025).

[17] Dr. Messé explained that the note that Petitioner was in her "usual state of health" signified that she had no other complaints prior to the stroke. Tr. at 163.

[18] As discussed above, the Esenwa review proposed that elevated inflammatory markers like CRP are associated with stroke. Esenwa at 594, 597. The authors surmised that the inflammatory products of the innate immune system might induce a hypercoagulable state, leading to stroke. *Id.* at 602. Petitioner, however, had normal inflammatory markers and a negative hypercoagulable workup, suggesting her stroke was not causally related to acute inflammation.

Dr. Boylan did not dispute that the hospital records did not show clinical or laboratory indications of inflammation before or at the time of the initial stroke. Tr. at 101-02, 113. She instead cited the intake form completed by Petitioner for her April 20, 2016 visit with Dr. El-Gengaihy. *Id*. at 121-23. On that form, Petitioner described her complaint as "[follow-up] after TIA and [left] deltoid flu shot [with] 'fever' in my shoulder, neck, chest and scapular region," which had been ongoing "since" March 22, 2016. Ex. 10 at 5. But on the same form, Petitioner stated that she had experienced a TIA *on March 22, 2016*, when her stroke actually occurred on March 30. *Id*. This suggests a faulty memory of the events preceding this visit, which is consistent with Petitioner's testimony that she had had memory problems since her stroke. *See* Tr. at 14. An exam conducted by Dr. El-Gengaihy that day showed no evidence of ongoing inflammatory symptoms. Ex. 10 at 9. This form is unpersuasive evidence of pre-stroke inflammation and insufficient to override the contemporaneous records.

There is also evidence of an alternative cause of Petitioner's stroke: her carotid web. Although a petitioner does not bear the burden of eliminating all alternative causes for her injury, it is appropriate for a special master to consider evidence relating to such alternative causes in assessing the *Althen* prongs. *See, e.g., Doe 11 v. Sec'y of Health & Hum. Servs.*, 601 F.3d 1349, 1357-58 (Fed. Cir. 2010); *Walther v. Sec'y of Health & Hum. Servs.*, 485 F.3d 1146, 1151 (Fed. Cir. 2007). As discussed above, both experts agreed that Petitioner had this condition and that it is a risk factor for stroke. Furthermore, according to the literature supplied by Dr. Boylan, that risk affects patients around Petitioner's age, even if the general risk of stroke is low in younger patients. *See* Choi at 2135 (reporting that the mean age of the patients with carotid web who suffered stroke was 50, with an age range of 41-55); Haussen at 1 (reporting that the median age of 24 patients with carotid web and stroke was 46, with an age range of 41-59); Sajedi at 1399 (reporting that the mean age of patients with stroke and carotid web was 38.9, with an age range of 30-48). And, as discussed, the literature does not suggest that a catalyzing agent is needed to trigger a stroke in a person with carotid web.[19]

For the reasons articulated above, I find that Petitioner has not preponderantly demonstrated a logical cause-and-effect sequence connecting the subject vaccination and her initial stroke, and therefore she has not established the second prong of *Althen*.

D. *Althen* Prong Three

The timing prong contains two parts. First, a petitioner must establish the "timeframe for which it is medically acceptable to infer causation," and second, he must demonstrate that the onset of the disease occurred in this period. *Shapiro v. Sec'y of Health & Hum. Servs.,* 101 Fed. Cl. 532, 542-43 (2011), *recons. denied after remand on other grounds*, 105 Fed. Cl. 353 (2012), *aff'd without op.*, 503 F. App'x. 952 (Fed. Cir. 2013). Here, it is undisputed that Petitioner suffered her initial stroke eight days after her March 22, 2016 flu vaccination. Thus, the operative question is

[19] Dr. Boylan opined that because Petitioner did not have strokes before or after the events in 2016, her vaccine was probably the causal factor precipitating her initial stroke. Tr. at 84. This is unpersuasive. The mere temporal relationship between a vaccination and an injury is insufficient to establish causation. Moreover, Dr. Messé persuasively explained that a carotid web poses a risk of, but does not "guarantee," recurrent strokes. Tr. at 214-15. He pointed out that although Petitioner had not yet experienced any further strokes, she remained at risk for further strokes due to her carotid webs. *Id.* at 215.

whether this onset was within the appropriate interval.

Dr. Boylan gave inconsistent opinions on the medically appropriate time for onset of stroke following vaccination. In her expert report, she stated that post-infectious neurological symptoms "typically start within 2-6 weeks following exposure." First Boylan Rep. at 3. That is longer than the onset period here. Also, the basis for Dr. Boylan's opinion was the Marchioni paper, which concerned encephalitis, myelitis, and encephalomyelitis, not stroke. Marchioni E, et al., *Postinfectious neurological syndromes*, NEUROLOGY (2013);80:882-889 (Ex. 32) ("Marchioni") at 883. Moreover, Marchioni did not report a 2-6-week timeframe for onset of those conditions following exposure. Instead, the inclusion criteria for the study specified that onset had to have occurred within 30 days of infection/vaccination.[20] *Id.*

At hearing, Dr. Boylan testified that she could not identify a specific time frame during which the inflammation from vaccination – her proposed causal mechanism – could precipitate a stroke. Tr. at 115-16. She stated: "The timing . . . on the inflammation is really not known[.]" *Id.* at 115. She maintained, however, that an eight-day onset following flu vaccination was medically appropriate and consistent with her mechanistic theory. *Id.* at 48. Dr. Messé agreed that the stroke occurred during the period that the body would produce an inflammatory response to an infection, but he noted that the Smeeth study showed a reduced risk of stroke during that same period following vaccination. *Id.* at 212-13.

Overall, Dr. Boylan's equivocation on the appropriate onset timeframe further undermined the persuasiveness of her testimony. She did not attempt to characterize the inflammatory properties of the flu vaccine, and thus she also could not define the timeframe during which vaccine-caused inflammation could trigger a stroke. Because Petitioner did not supply reliable expert testimony or other evidence supporting an eight-day onset of stroke following flu vaccination, I conclude that she has not satisfied *Althen* prong three.

E. Other Vaccine Cases

A limited number of cases alleging stroke caused by flu vaccination have been filed in the Vaccine Program. Although prior decisions from different cases do not control the outcome here, they can inform my analysis. *See Boatmon*, 941 F.3d at 1358-59.

First, Petitioner submitted *Irwin*, in which Special Master Gowen found entitlement to compensation, as an additional authority for my consideration. *Irwin v. Sec'y of Health & Hum. Servs.*, No. 16-1454V, 2024 WL 863690 (Fed. Cl. Spec. Mstr. Jan. 23, 2024). Unlike this case, the petitioner in *Irwin* felt ill immediately after receiving a seasonal flu vaccination and suffered a stroke two days later. *Id.* at *2-3. The petitioner's expert relied on two case reports describing patients who had strokes within two days of vaccination, along with the Hingorani study. *Id.* at *17-18. Here, Dr. Boylan did not adequately substantiate her causal theory. Moreover, the theory she advanced is not consistent with the facts of this case, which, as noted, involved a stroke eight days after vaccination, without evidence of a significant inflammatory response in the interim.

[20] The study also identified an average period of 8.2 days from onset to maximum dysfunction, which is irrelevant to the question posed here. Marchioni at 883.

Another case I have identified is *Sokol*. *Sokol v. Sec'y of Health & Hum. Servs.*, No. 16-1631V, 2020 WL 553842 (Fed. Cl. Spec. Mstr. Jan. 9, 2020). The petitioner in *Sokol* suffered from a subarachnoid hemorrhagic stroke approximately 10 days after vaccination. *Id.* at *2. Special Master Moran found that the theory of causation, which was similar to that presented here, was inadequate. *Id.* at *6. Specifically, he found that the theory that "inflammation" can cause stroke to be too generalized to satisfy *Althen* prong one. *Id.* at *5. Further, although a cytokine-driven response within four days of vaccination was medically acceptable, that timeline was inconsistent with the 10-day onset of the petitioner's stroke. *Id.* at *8.

Another case involving the flu vaccine and hemorrhagic stroke is *Schultz*. *Schultz v. Sec'y of Health & Hum. Servs.*, No. 16-539V, 2020 WL 1039161 (Fed. Cl. Spec. Mstr. Jan. 24, 2020). In *Schultz*, Dr. Boylan served as a petitioner's expert and, as here, relied on case reports and broad generalizations, without specific evidence tying the flu vaccination to the injury. *Id.* at *22. Chief Special Master Corcoran was unpersuaded by Dr. Boylan and found Dr. Messé more credible. *Id.* at *22-23. Further, although the petitioner in *Schultz* suffered from normal arm soreness and a low-grade fever after vaccination, her stroke occurred more than 30 days after vaccination, which was too nonspecific a course to support vaccine causation. *Id.* at *13, 24.

Although none of these decisions are binding here, I am persuaded by the reasoning in *Sokol* and *Schultz*. As in *Schultz*, Dr. Boylan here failed to substantiate her theory of causation with vaccine-specific information. Instead, she rested on the broad proposition that inflammation can cause stroke, and vaccines produce an inflammatory response of some kind. Tellingly, it appears that Dr. Boylan presented a similar theory in this ischemic stroke case as she did in *Schultz*, a hemorrhagic stroke case, even though she testified that hemorrhagic stroke is mechanistically distinct from ischemic stroke. *See* Tr. at 32 (testifying that a hemorrhagic stroke is caused by rupture of a blood vessel, while ischemic stroke is caused by choking off the blood supply to the brain). This broad-brush theorizing across different fact patterns and conditions lessens the persuasiveness of Dr. Boylan's opinions here. *Cf. Schultz*, 2020 WL 1039161, at *22 ("Petitioner's experts too often relied on literature that conflated ischemic with hemorrhagic strokes, or other types of vasculitis, without showing that the specific kind at issue in this case could reliably be associated with the flu vaccine."). Furthermore, as in both *Sokol* and *Schultz*, the records in this case do not comport with the mechanistic theory advanced, in that they do not signify a significant inflammatory response in the days following Petitioner's vaccination.

VI. CONCLUSION

I am sympathetic to Petitioner's ordeal. However, upon careful evaluation of all the evidence submitted in this matter, including the medical records, Petitioner's statement, the expert reports, the testimony, and the medical literature, I conclude that she has not shown by preponderant evidence that she is entitled to compensation under the Vaccine Act. **Her petition is therefore DISMISSED. The clerk shall enter judgment accordingly.**[21]

IT IS SO ORDERED.

[21] Pursuant to Vaccine Rule 11(a), the parties may expedite entry of judgment by each filing (either jointly or separately) a notice renouncing their right to seek review.

s/ Jennifer A. Shah
Jennifer A. Shah
Special Master